Prairie Habitat Joint Venture Habitat Monitoring Program Phase I: Recent habitat trends in NAWMP targeted landscapes.

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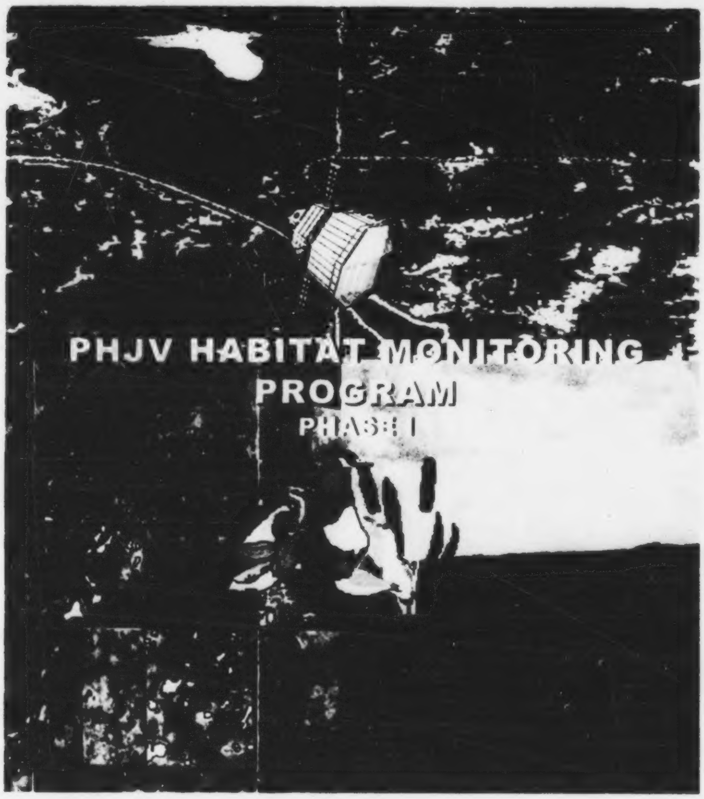

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SUMMARY FINDINGS

This report presents results from Phase I of the Prairie Habitat Joint Venture Monitoring Program. The program was designed to provide an evaluation of habitat trends within PHJV target areas, and establish a foundation for a long-term habitat monitoring program. PHJV activities within the NAWMP targeted areas have not been of sufficient magnitude to completely halt the continuing loss of wetlands. Whether PHJV activities resulted in relatively less wetland loss than in areas not targeted by PHJV activities is difficult to discern because comparable data regarding losses outside of target areas was not collected. Nevertheless, there is some evidence that suggests that the management activities of the PHJV have had a measured positive impact barring some compensatory types of wetland destruction activities.

Wetlands (Habitat Monitoring Transect Results)

Wetland habitat was evaluated by comparing Habitat Monitoring Transects conducted using air photos and ground-truthing in 1985 to updated ground-truthed and digitized data from 1999. A total of 56 monitoring transects encompassing 1304 quarter sections (86,939 ha) sampled 0.63 % of the entire land area within NAWMP targeted landscapes.

- Gross wetland area loss within the PHJV target areas between the years 1985 to 1999 is estimated to be -3.7 % or 53,492 +/- 16,850 ha of the estimated 1.43 million +/- 190,000 ha of wetlands.
- Comparisons with wetland loss studies from previous time periods indicate that annual rates in the loss of wetland numbers have remained fairly constant. However, there is limited evidence which suggests that the annual loss of wetland area has declined from previous time periods.
- Upland area replacing wetland area included agriculture (67.0%), rural development (10.3%), and other up-lands (22.7%).
- Between 1985 and 1999, wetland area immediately adjacent to cultivated upland cover decreased from 59 % to 56 % of the total surveyed wetland area.
- The gains in open water/deep marsh habitat on NAWMP intensive quarters accounted for 46 % of the overall total wetland area gains for these cover types
- The mean size of complete wetland basins losses was 0.27 ha.

- Between 1985 and 1999 grass and sedge basin area decreased from 57 % to 55 %, and cultivated basin area increased from 13 % to 14 % of the total wetland area sampled.

- Between 1985 and 1999 open water basin area increased from 13 % to 14 %, and deep marsh basin area increased from 5 % to 6 % of the total wetland area sampled.

Uplands (Census of Agriculture and Habitat Monitoring Transects Results)

Upland habitat was evaluated by comparing Habitat Monitoring Transects conducted using air photos and ground-truthing in 1985 to updated ground-truthed and digitized data from 1999. The Agricultural census data provided information on land cover and landuse changes for 100,989 farms (37,126,363 ha) in non-targeted lands and 40,039 farms (15,671,872 ha) in targeted lands. The combination of the two datasets allowed for accurate reporting of major land use trends within the PHJV.

Trend analysis results reported by both the Agricultural census and the monitoring transects reported similar trends. AG census data provided a measure of total landscape as well as a comparison between targeted and non-targeted lands, the major findings of this comparison are outlined below:

- Total cultivated land on target and non-target areas has decreased. Summerfallow has decreased in targeted and non-targeted landscapes. Annually cropped land has increased in targeted and non-targeted landscapes. Overall, more land has come out of cultivation on targeted landscapes then non-targeted. As of the 1996 census of agriculture it was reported that 57.46 % of the total land area of targeted landscapes was under cultivation and 58.02 % of the total land area of non-targeted lands was cultivated.

- Between 1986 and 1996 the total area of all other land (includes idled lands, and other habitat type lands) increased slightly on targeted and non-targeted land areas. This change did not significantly affect overall land composition of targeted and non-targeted lands which increased by 0.26 % and 0.01 % of the total land base respectively.

- Between 1986 and 1996 natural land being used for pasture declined in targeted areas and non-targeted areas. As of 1996, 25.21 % of the total area of targeted lands was reported as natural land for pasture, and 26.13 % of the total non-targeted land area was reported as natural land for pasture.

- Tame pasture, and tame hay increased in targeted and non-targeted lands. As of 1996, 11.48 % of the total area of targeted land and 12.93 % of non-targeted lands was reported as tame pasture and tame hay combined.

RÉSUMÉ

Le présent rapport résume les résultats de la phase I du programme de surveillance du Projet conjoint Habitat des Prairies (PCHP). Le programme de surveillance avait pour objectif de fournir une évaluation des tendances observées dans les habitats composant les zones cibles du PCHP et d'établir les bases d'un programme de surveillance à long terme des habitats. L'ampleur des activités du PCHP menées dans le cadre du PNAGS n'a pas suffi à mettre fin complètement à la perte continue de milieux humides. Il est difficile d'établir si les activités du PCHP ont débouché sur une perte relativement moins importante de milieux humides dans les zones visées par le Projet que dans les zones non visées, car aucune donnée comparable n'a été recueillie sur les pertes de milieux humides dans ces dernières zones. Néanmoins, certaines données laissent croire que les activités de gestion du PCHP ont eu un impact positif observable, mis à part certains types compensatoires d'activités de destruction de terres humides.

Milieux humides (résultats des transects de surveillance des habitats)

On a évalué les milieux humides en faisant la comparaison entre, d'une part, les transects de surveillance des habitats établis en 1985 grâce à des photos aériennes et à des vérifications sur place et, d'autre part, des données numérisées et mises à jour en 1999 par des vérifications place. Au total, 56 transects de surveillance répartis dans 1 304 quarts de section (86 939 ha) ont permis d'échantillonner 0,63 % de tout le territoire formant les zones visées par le PNAGS.

- Entre 1985 et 1999, la perte brute estimée de milieux humides compris dans les zones cibles du PNAGS s'est établie à -3,7 %, soit 53 492 +/- 16 850 ha, par rapport à une superficie humide totale estimée à 1,43 million +/- 190 000 ha.

- La comparaison avec des études sur la perte de milieux humides pour des périodes antérieures indique que les taux de perte annuels sont demeurés relativement constants. Cependant, quelques données laissent croire que la perte annuelle de superficies humides aurait diminué par rapport aux périodes antérieures.

- Les utilisations suivantes ont favorisé le remplacement des milieux humides par des milieux secs : agriculture (67,0 %), développement rural (10,3 %) et autres utilisations (22,7 %).

- Entre 1985 et 1999, la superficie des milieux humides qui sont contigus à des milieux secs cultivés a diminué, passant de 59 % à 56 % de la superficie humide totale étudiée.

- Entre 1985 et 1999, la superficie des milieux humides où il n'y a aucune activité dans le bassin a augmenté, passant de 53 % à 58 % de la superficie humide totale étudiée.

- La superficie moyenne des bassins humides qui ont entièrement disparu était de 0,27 ha.

- Entre 1985 et 1999, la superficie des bassins à graminées et à carex a chuté, passant de 57 % à 55 %, et celle des bassins à espèces cultivées a crû, passant de 13 % à 14 %, par rapport à la superficie humide totale étudiée.

- Entre 1985 et 1999, la superficie des bassins à eau libre tout comme celle des bassins à marais profonds ont progressé, passant dans le premier cas de 13 % à 14 % et dans le deuxième cas de 5 % à 6 % par rapport à la superficie humide totale étudiée.

Milieux secs (Recensement de l'agriculture et résultats des transects de surveillance des habitats)

On a évalué les milieux secs en faisant la comparaison entre, d'une part, les transects de surveillance des habitats établis en 1985 grâce à des photos aériennes et à des vérifications sur place et, d'autre part, des données numérisées et mises à jour en 1999 par des vérifications place. Le Recensement de l'agriculture a fourni de l'information sur les changements survenus dans le couvert végétal et les utilisations du sol pour 100 989 fermes (37 126 363 ha) installées dans des zones non cibles et pour 40 039 fermes (15 671 872 ha) installées dans des zones cibles. La combinaison des deux ensembles de données a permis d'établir avec exactitude les principales tendances en matière d'utilisation du sol dans les zones cibles du PCHP.

L'analyse des données du Recensement de l'agriculture et des résultats des transects de surveillance a permis d'observer des tendances similaires. Les données du Recensement de l'agriculture ont fourni de l'information sur l'ensemble du territoire et permis de faire une comparaison entre les zones visées et non visées. Voici les grandes lignes de cette comparaison:

- La superficie totale des terres cultivées dans les zones visées et non visées s'est amenuisée. La superficie des terres en jachère a diminué tandis que celle des terres exploitées sur une base annuelle a augmenté, dans les zones visées comme dans les zones non visées dans les deux cas. De façon générale, de plus grandes superficies ont été retirées de l'agriculture dans les zones visées que dans les zones non visées. Selon les données du Recensement de l'agriculture de 1996, 57,46 % de la superficie totale était consacrée à l'agriculture dans les zones visées et 58,02 %, dans les zones non visées.

- Entre 1986 et 1996, la superficie totale de toutes les autres terres (y compris les terres en friche et les terres regroupant d'autres types d'habitat) a augmenté légèrement dans les zones tant visées que non visées. Cette augmentation n'a pas eu de conséquence significative sur la composition générale du territoire dans les zones visées et les zones non visées, car elle n'était respectivement que de 0,26 % et de 0,01 % de l'ensemble du territoire.

- Entre 1986 et 1996, la superficie non cultivée utilisée pour les pâturages a régressé dans les zones visées comme dans les zones non visées. En 1996, elle s'établissait à 25,21 % de la superficie totale des zones visées et à 26,13 %, de celle des zones non visées.

•La superficie consacrée aux pâturages cultivés et au foin cultivé a progressé à la fois dans les zones visées et non visées. En 1996, elle représentait 11,48 % de la superficie totale des zones visées et 12,93 %, de celle des zones non visées.

ACKNOWLEDGEMENTS

Gerald McKeating and Trevor Swerdfager were the initial catalysts for this project.

Dr. Jack Millar put together a tremendously sound baseline dataset which he designed for the purposes of providing a tool for answering future questions such as those asked by the PHJV. Mr. Millar's attention to detail and scientific understanding of the strengths and limitations of wetlands and uplands habitat monitoring tools enabled us the opportunity to build on a strong foundation for habitat monitoring in the PHJV.

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Mr. Tom Dahl and the staff of the USFWS and USGS provided a habitat trend reporting frame work from which to compare and learn from.

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INTRODUCTION

Habitat monitoring and trend reporting is an important part of the program for the Prairie Habitat Joint Venture, particularly as we seek to target conservation programming effectively across the prairie grasslands. As noted in the 1999-2004 PHJV Strategic Framework, understanding the prairie landscape is essential and the PHJV Habitat Monitoring Program has been designed to do just that. To date, efforts have focused on integrating data from a number of sources to derive meaningful estimates of habitat change that have occurred across the prairie ecozone since the inception of NAWMP. This report culminates 15 years ofeffort in wetland and upland monitoring across our key landscapes by the Canadian Wildlife Service. For the first time, we have a glimpse into the rate of wetland losses that have occurred since 1985 across all PHJV target areas. Without a doubt, the results presented in this report will help guide program delivery and will help all partners evaluate conservation programs against what appears to be an ever changing prairie system.

As for the next 10 years, we will be adapting and improving on the habitat monitoring network that has been in existence since the beginning of NAWMP. Technologies in remote sensing and geographic information systems will continue to evolve making the task easier and more cost effective. In addition, we will expand the program to assess and monitor trends to support the implementation of the North American Bird Conservation Initiative. In this way, we will support the evolution of the PHJV towards implementation of conservation for all birds and their habitats.

David Ingstrup
Chief - Wildlife Conservation
Canadian Wildlife Service, Environment Canada
Prairie and Northern Region

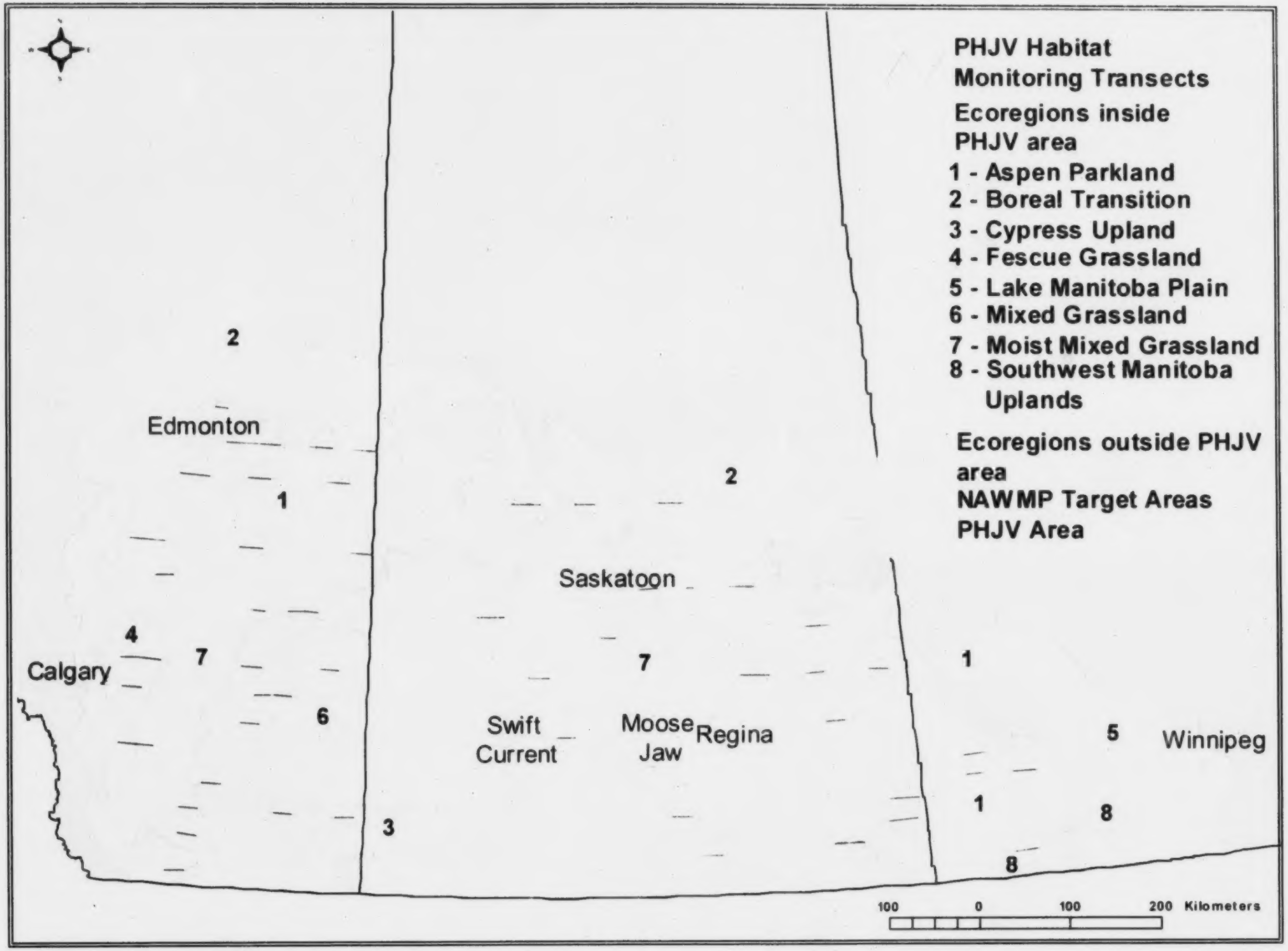
STUDY AREA

The study area is located within the Prairie Habitat Joint Venture (PHJV) delivery boundary, with the primary focus on the lands contained within the NAWMP targeted areas, excluding the Grand Prairie and Peace River portions of Alberta (Figure 1). Target areas are located in southwestern Manitoba, southern Saskatchewan, southeastern Alberta, and the Grande Prairie region of north western Alberta. Combined, these areas include the majority of the Prairie ecozone, represent the most productive waterfowl habitat in the region, and are the focus of PHJV programming efforts. For comparative purposes landscapes outside targets were lumped by ecoregions. Agricultural census data also reports on the Peace River and Grand Prairie region of Alberta but, is considered as a separate landscape.

Sampled landscapes are dominated by morainal type parent material with various surface forms including knob and kettle, undulating, dissected, hummocky and rolling. The sampled landscapes contain high wetland densities and are composed of various habitat types and land use practices. The following table lists the ecogregions contained within the PHJV boundary area, please Refer to The National Ecological Framework for Canada (1996) for more information regarding Canada's ecological frame work. For reporting purposes ecogregions were lumped into either Grasslands or Parkland Boreal Transition (Table 1).

Ecoregion	
Aspen Parkland	**Parkland/Boreal Transition**
Boreal Transition	
Lake Manitoba Plain	
Southwest Manitoba Uplands	
Cypress Upland	**Grasslands**
Mixed Grassland	
Moist Mixed Grassland	
Fescue Grassland	

Table 1. Principle ecoregions represented within the PHJV boundary.



PHJV Habitat Monitoring Transects
Ecoregions inside PHJV area
1 - Aspen Parkland
2 - Boreal Transition
3 - Cypress Upland
4 - Fescue Grassland
5 - Lake Manitoba Plain
6 - Mixed Grassland
7 - Moist Mixed Grassland
8 - Southwest Manitoba Uplands
Ecoregions outside PHJV area
NAWMP Target Areas
PHJV Area
Edmonton
Calgary
Saskatoon
Swift Current
Moose Jaw
Regina
Winnipeg
2
1
4
7
6
3
2
7
1
5
1
8
8
100
0
100
200 Kilometers

Figure 5. PHJV Habitat Monitoring Study Area.

METHODS

Habitat Monitoring Baseline

The original purpose of this work was to establish a baseline record of habitat conditions using the previous work of Millar (1987a) to which future habitat monitoring work could be compared. The work completed by Millar was updated using modern technologies and techniques, and formed the habitat baseline from which habitat change detection was implemented. The following section outlines the original design of the habitat monitoring sampling network as well as incorporates methods used in reproducing and updating this work.

Landscape Stratification

The original habitat monitoring program conducted by Millar was designed to sample the an area slightly larger then the Prairie ecozone, which is approximately equal to the PHJV delivery boundary. In order to ensure adequate sample distribution it was necessary to stratify the landscape by units representative of localized conditions such as soils, landform, vegetation and wetland components. The unit of stratification selected was the Habitat Subregion (See Appendix I), which was considered optimal for local and regional management planning for migratory bird conservation (Adams 1988).

Sampling Network

In 1985, 152 habitat monitoring transects were established through-out the Prairie ecozone (Figure 2). The core of this sampling network was composed of 65 annually surveyed CWS air/ground segments which are part of the USFWS/CWS Waterfowl Breeding Population and Habitat Survey program. Additional transects were added by a stratified random design, to sample baseline habitat conditions in as many of the larger Habitat Subregions as possible.

In 1999, all transects which were completely contained or had any portion of their sampled area within NAWMP targeted landscapes were updated. A total of 56 transects (32 in Alberta, 20 in Saskatchewan, and 4 in Manitoba) were selected for updating in 1999. Two of the 6 transects surveyed in Manitoba in 1999 were excluded from the analysis because of technical difficulties with the baseline air photos.

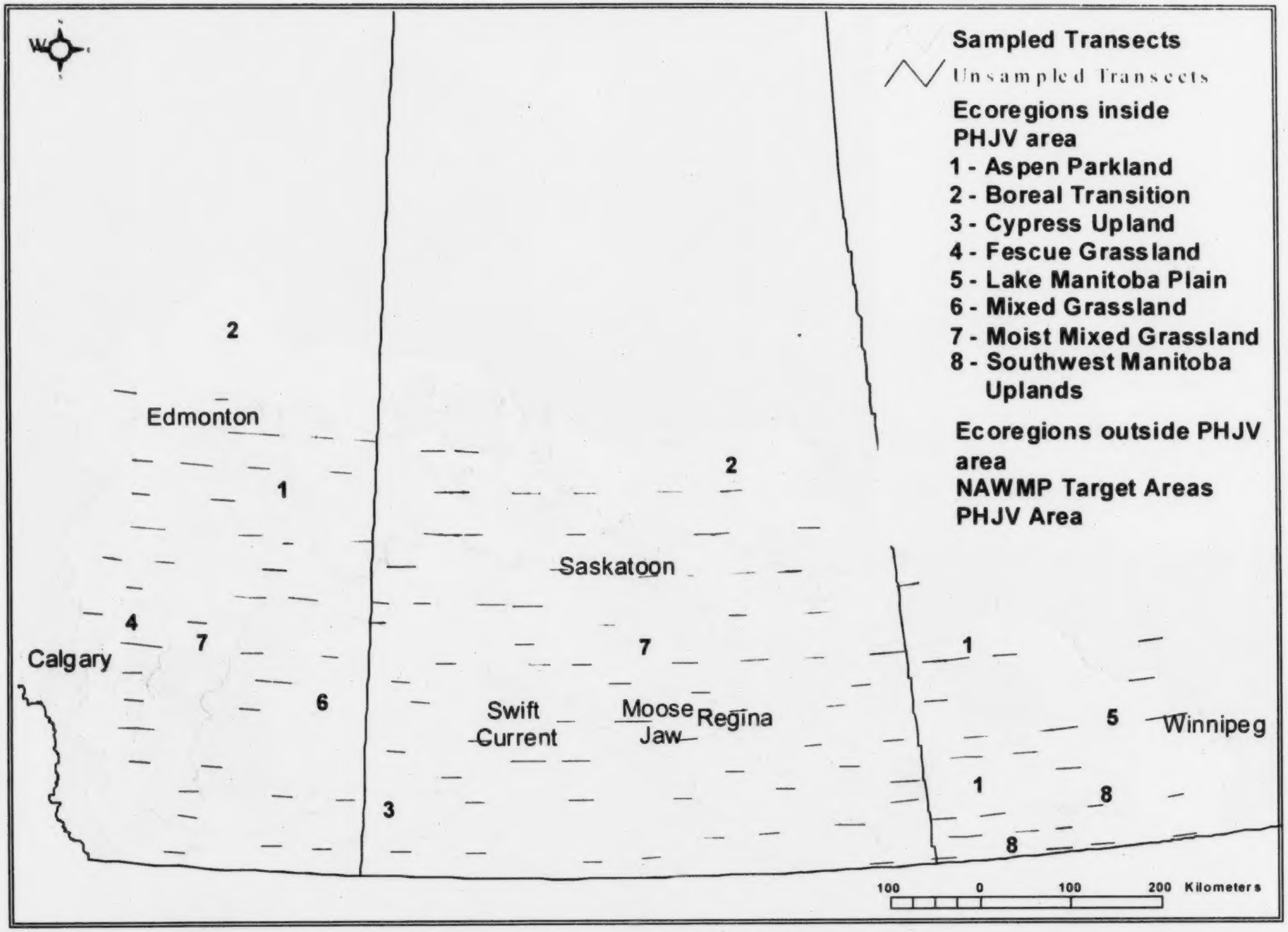

Sampled Transects
Unsampled Transects
Ecoregions inside PHJV area
1 - Aspen Parkland
2 - Boreal Transition
3 - Cypress Upland
4 - Fescue Grassland
5 - Lake Manitoba Plain
6 - Mixed Grassland
7 - Moist Mixed Grassland
8 - Southwest Manitoba Uplands
Ecoregions outside PHJV area
NAWMP Target Areas
PHJV Area
Edmonton
Saskatoon
Calgary
Swift Current
Moose Jaw
Regina
Winnipeg
2
1
4
7
6
3
2
7
1
5
1
8
8
100
0
100
200
Kilometers

Figure 6. Transect distribution within the PHJV delivery boundary, inside and outside target areas.

Transect Design

Most transects were located along west-east grid roads. The original transect design by Millar sampled every second quarter section alternating north and south of the transect mid line (often a grid road) in a west to east direction (Figure 3). The starting quarter section was determined randomly and set the sampling pattern for the remainder of the transect. The average length of a transect was 19.2 km (12 mile) with an average area of 1536 Ha or 24 quarter sections sampled per transect.

Figure 7. An example of a PHJV habitat monitoring transect (One square = 1 quarter section = 800m x 800m).

Baseline Aerial Photography

The aerial photography from which the baseline habitat values were derived was 1:24000 false color infra-red imagery obtained in May of 1985, provided by USFWS.

Baseline Habitat Mapping

The following process was completed by CWS and Lands Directorate staff in 1985 – 1986 (Millar 1985a).

1. Habitat Interpretation

The initial step was to identify sampled quarter section boarders on baseline air photos and delineate their boundaries. The boundary included half the width of all road allowances bordering the quarter section boundary. Air photos were then overlaid with Mylar sheets and habitat polygons were delineated for all classified habitats within each quarter section boundary. Habitat polygons were interpreted using magnifying stereoscopes, and delineated by hand on the Mylar sheet. Effort was made to delineate the smallest habitat feature possible. Habitat polygons too small to hand draw accurately were identified with a single point. Each polygon was given a unique identifier and relevant habitat data codes. All questionable polygons were ground-truthed and updated as necessary.

2. Habitat Classification

All data was recorded on a polygon classification data form (see Appendix II). Data included polygon number, identifier codes, land cover, land activity, wetland identification, primary and secondary wetland margin cover, wetland impacts, and general comments. Wetland specific codes were only recorded for wetlands. See Appendix II for a complete list of classification types.

Habitat Polygon Delineation

A total of 18 cover classes were interpreted for the baseline data creation. Cover categories were in accordance with the Lands Directorate's Canada Land Use Monitoring Project (C.L.U.M.P.) classification. All baseline habitat polygons were intensively ground-truthed.

Wetlands

Wetland basins were mapped according to their basin boundary, water presence or absence was not a major influence on the basin delineation. Basins were delineated through the mapping of the depression in the land and other features such as vegetative changes and identifiable margins. Wetlands were most often delineated by one polygon, however, in multi-polygon wetlands the entire wetland was classified according to the polygon which had cover indicative of the highest level of water permanence (Millar 1987a).

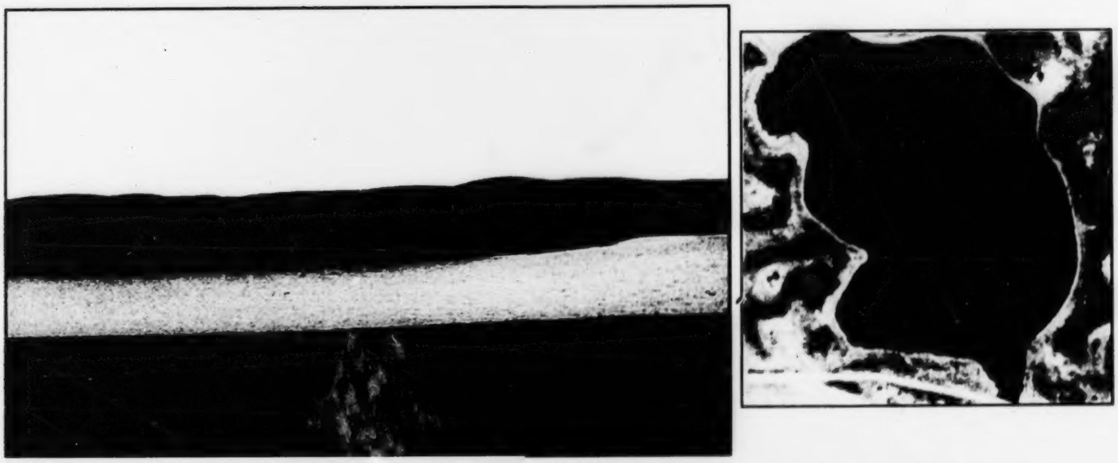


Figure 8. Natural Open Water wetland ground photo on left, remotely sensed image on right.

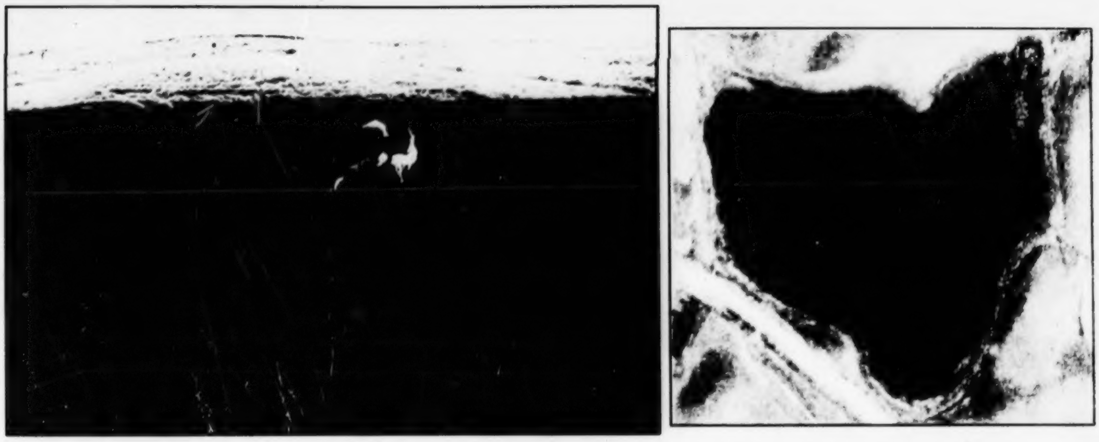


Figure 9. Deep Marsh wetland ground photo on left, remotely sensed image on right.

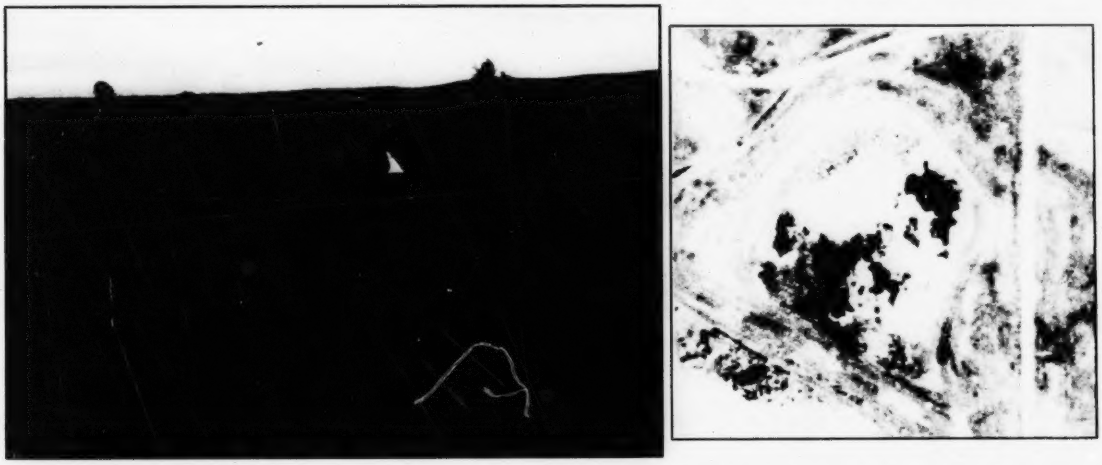


Figure 10. Grass and Sedge or seasonal type wetland ground photo on left, remotely sensed image on right.

Figure 11. Grass and sedge or temporary type wetland in a cultivated field.

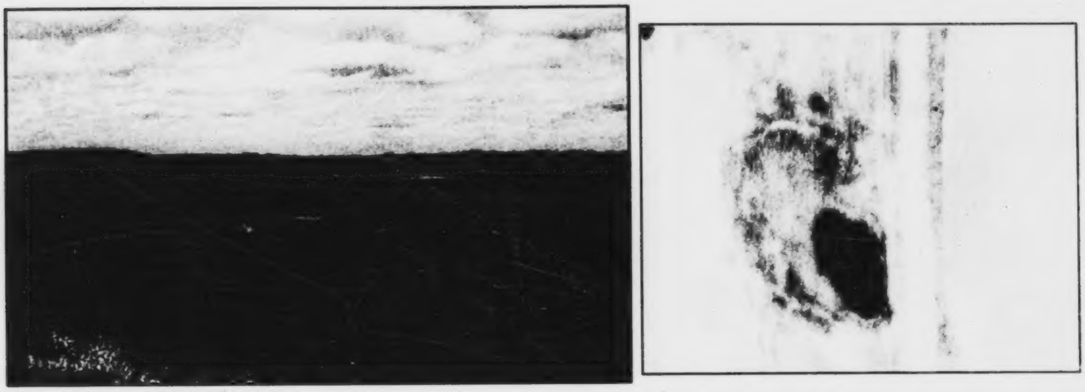
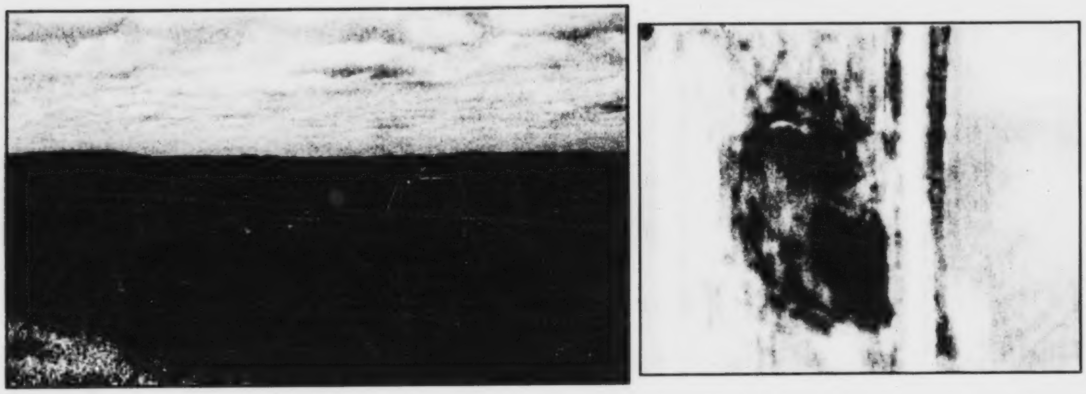


Figure 12. Cropped wetland.

Wetlands were classified by the dominant vegetative community that was representative of the wetlands ecological function. The following table describes the types of wetlands mapped during baseline habitat interpretation.

Wetland Classification	***Description***
Open Water Ponds and Lakes	Permanent open water type habitat, separate categories for saline lakes and ponds, streams and rivers and other open water type habitats.
Artificial Open Water Wetlands	Dugouts, irrigation ditches cannels and reservoirs.
Emergent Deep Marsh	Dominated by deep marsh emergent vegetation such as *Scirpus sp.* and *Typha sp.*
Shallow Marsh and Wet Meadows	Grass and sedge dominated wetlands. Shallow marsh to low prairie type wetlands.
Wooded Wetlands	Shrub or tree cover dominated basins intermixed with wet meadow type vegetation.
Cropped Wetlands	Essentially sheet water areas dominated by cropped cover or disturbance species associated with repeated cultivation.

Table 2. Wetland classes and descriptions.



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Cropped Wetlands	Essentially sheet water areas dominated by cropped cover or disturbance species associated with repeated cultivation.

Table 2. Wetland classes and descriptions.

Every mapped wetland polygon was assigned the following: a cover code which, as described above, reported the dominant cover type for the wetland; an activity code, which described the land use activity present within the wetland basin at the time of mapping, and also determined the specific use applied to a cover type i.e. forage crop or tame pasture; a margin code describing the cover type of the wetland margin (classified as either natural grass cover, shrub cover or non-natural cover type i.e. cropland). Wetland basin impacts were also recorded for every wetland mapped.

Uplands

Uplands were delineated for every sampled quarter section along the habitat monitoring transect. Uplands polygons were delineated based on land cover type and natural vegetation breaks between different cover types. Upland habitat polygons were also delineated based on land use differences, between like cover types, for example an unimproved pasture may have been subdivided within a sampled quarter section, one portion may have been grazed and another portion idled. In a case like this the upland polygon would be divided based on the pasture layout, thus a uniform cover type would be divided into two separate polygons with differing activity codes. Like wetlands, the upland polygons were described by the dominant cover and activity type occurring within the delineated boundary. For a complete list activity codes please refer to Appendix II.

Upland Classification	*Description*
Woodlands	Separate categories for trees, shelterbelts, shrubs, and low shrubs i.e. "buckbrush".
Annually Cultivated Crops	Cropland and stubble.
Summerfallow and Bare ground	Natural bare ground identified by the activity code associated with it.
Other Non-woody Plants	Complexes of disturbance species.
Constructed Cover	Man made cover, structures etc.
Improved Grass and/or Legume Cover	Tame pasture or forage crops, differentiated by the associated activity code.
Unimproved Grassland	Primarily native grasslands, remnant grass cover, and uncultivated perennial cover (no detectible inputs i.e. mowing, seeding, haying etc).

Table 3. Upland habitat classes.

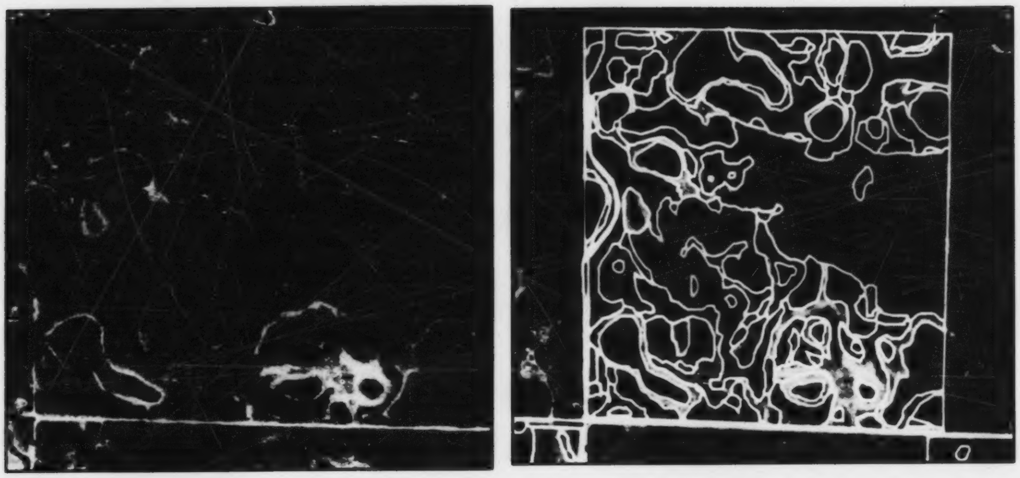

Figure 13. Example of a sampled quarter section, showing habitat delineations by polygons.

Uplands and wetlands could share the same cover code as they were differentiated by the presence or absence of a wetland identifier code (wetland number). An example of this is the unimproved grass code which is the same as the grass and sedge code, if the polygon was a wetland it would be identified by a wetland number and would also contain wetland margin information.

Change Detection and Updating

In 1999, all sampled quarter sections were revisited and ground-truthed for change detection purposes. New imagery was not purchased for updating. Existing baseline photos with accompanying polygon delineations were reproduced to enable accurate change detection (See Appendix II). Magnified copies of the 1985 imagery and polygon attribute data were updated in the field. The object of the field verification was to update polygon attributes, alter or delete polygons based on measurable habitat boundary changes, and add polygons to delineate post baseline land cover changes.

Wetland Change Reporting

Measured wetland loss data represents the area of wetland removed from the landscape. Losses recorded are considered permanent, whereby the area was no longer considered as wetland habitat (i.e. no longer capable of holding water) and was reclassified as an upland category. Wetland loss summary statistics are divided into gross wetland losses and net wetland habitat change. Wetland loss was determined by the entire or partial deletion of the respective polygon. Low or high water conditions were not considered indicators of basin change, and hence basin polygons were deleted or expanded only if actual measurable physical changes occurred to the basin itself. Because new imagery was not purchased, it was not possible to record minor boundary changes. The only wetland changes recorded were those that could be reliably determined from the existing baseline comparison to conditions at the time of the 1999 ground survey.

Habitat area gains, both wetland and upland, were measured in the field and the new polygons were delineated on the magnified air photos. Gains were only considered if they could be adequately mapped from the baseline air photo. Therefore, it was not possible to record slight boundary changes in uplands or wetlands habitat. All wetland gains were reviewed against the existing baseline data using the original stereo pairs to ensure the gain was post 1985. Recorded wetland gains were then separated into true wetland gains and false wetland gains. False wetland gains were polygons added in 1999 but, through examination were verified to be present on the 1985 imagery but, had been missed during baseline data interpretation.

Field verification required 2 – 3 man days to complete ground-truthing for an individual transect. All habitat polygons delineated from the 1985 survey were checked by either directly visiting or from a distance. Field mapping was aided by the use of high power optics, GPS and laser range finding technology.

Data Assembly

This section describes the methods used to create updated digital products from the hard copy baseline information collected and assembled in 1985 plus methods for updating the baseline with the 1999 survey results. For the purposes of this project it was determined that the baseline dataset had to be input into a Global Information System (GIS).

Habitat Polygon Attribute Data Assembly

All baseline habitat attribute data was entered into a database system incorporating data entry quality control and validation rules. Habitat polygon attribute data was then linked to the appropriate polygon in a GIS. The linked attribute data was then validated using an automated reporting system within the GIS.

Data collected during the 1999 field season was used to update the 1985 baseline. This new digital file was then linked to the 1999 habitat polygon within the GIS. Data validation was accomplished using the same methods as in the 1985 baseline.

Image Assembly

The majority of the transects were composed of 6 - 8 individual 1:24000 air photos. All images making up a complete transect were scanned into digital format and imported into a image processing software format. Individual images were then processed using image enhancement techniques. Images were then rectified using 1:20000 reference data with a spatial accuracy of +/- 5m. The rectified imagery was then mosaiced into a single spatially referenced image composed of 6 - 8 air photos. The mosaic was then color balanced, which corrected for abnormal reflectance, image distortions, and enhanced the image for interpretation and habitat polygon delineation. An example of a completed mosaic is illustrated in Figure 3.

Habitat Polygon Delineation and Attributing

Hardcopies of original 1985 baseline habitat polygons were reproduced in digital format using image processing software. The digitizing method used is referred to as "heads up digitizing". The heads up method is a process where by the mosaiced image is displayed on a computer screen and the polylines (lines making up a polygon) are delineated using mouse clicks along the perimeter of the polygon (Figure 10). Polylines were delineated along the original lines drawn on the hard copy product produced in 1985. During digitizing, it was possible to improve on the accuracy of boundary locations and missed polygons using the heads up method, because the scanned imagery could be "zoomed" during the digitizing process. Hence, the digital product was considered an improvement on the baseline hardcopy delineations.

Once digitized, the poly lines were then built into GIS compatible polygons using GIS software. Automated processes were used for quality control purposes and ensured accurate completion of the baseline habitat information. Assembled polygons were then joined with their appropriate habitat attribute from the database.

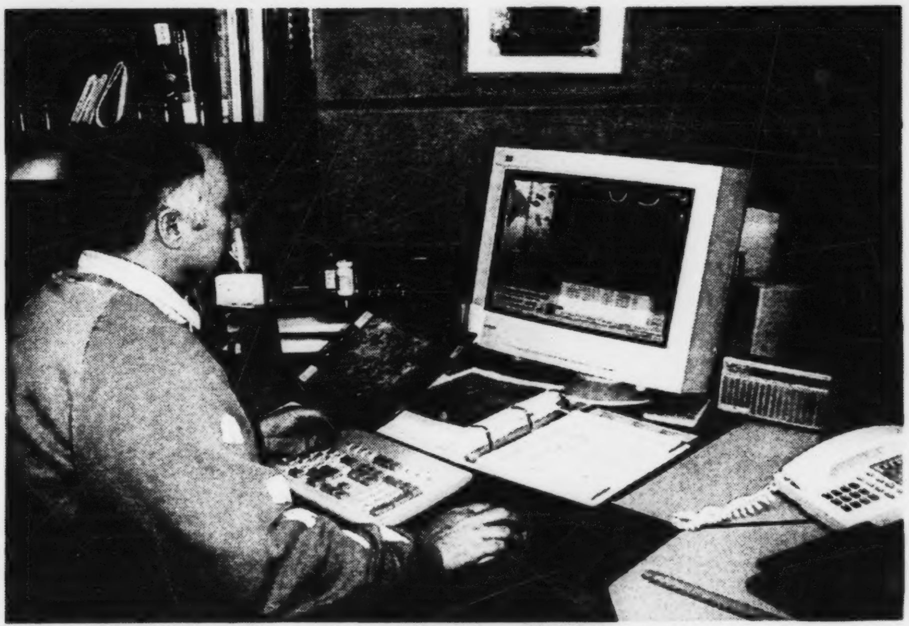

Figure 10. CWS staff member performing digitizing process.

Habitat Polygon Updating

In order to calculate upland and wetland habitat trends, it was necessary to create a new digital file for the updated information based on the 1999 field survey results. The digital baseline products created previously were updated based on the detailed field records described in previous sections. Polygons were updated either through boundary expansions or contractions, deletions, or additions. The 1999 field data was then joined to the new GIS file which updated the codes for each appropriate variable measured. The error checking process and validation rules applied were similar to the process used when creating the 1985 data.

Data Analysis and Reporting

Data analysis was completed using GIS technology. The GIS system was programmed to produce a change summary report for individual or selected groups of transects. All habitat areas were computed in hectares. Change data was calculated by comparing total areas, numbers, perimeters etc. for specific variables in the 1999 dataset with the numbers for the 1985 dataset. The percentage change values reported in this document were calculated by dividing the difference between the 1999 and 1985 datasets by the 1985 area for that variable. The GIS system could be programmed to report on any number of variables, including innumerable combinations of variables.

Lost wetland area was determined spatially through a clip process which identified uplands areas in the 1999 dataset which were wetlands in 1985. The lost wetland area determined through this process made up the gross wetland loss totals for the dataset. Wetland gains were identified using a clip process which identified areas that were upland in 1985 and in 1999 were recorded as wetland. This wetland gains area in combination with gross wetland loss area was used to calculate net wetland change for the dataset.

Net wetland losses were determined through measuring the total area of wetlands in 1999 in comparison to the total wetland area in 1985. Lost wetland area polygons created through this clip process were also used to identify the type of upland replacing the wetland area and therefore determined what impact resulted in the destruction of the wetland area. Uncertainties in lost wetland area polygons were verified with supplementary data such as more recent air photos, communication with annual air ground habitat survey staff, and field journal entries. False wetland area gains (described previously) were applied as a correction factor to the summarized data.

Wetland numbers were calculated using the wetland number identifier. In the case of multi-polygon wetlands, the wetland number remained the same for each polygon of a specific wetland and thus was treated as one wetland.

Upland change comparison was achieved in an identical process to that of the wetlands change detection method.

Reporting categories were constructed through the combination of various cover and activity codes. All summary data was error checked through verification with original hardcopies and updated field sheets. Reporting was completed for all variables and only summaries deemed relevant to the objectives of this study were reported in this document.

Agricultural Census Data

The Census of Agriculture queries land owners with questions designed to provide agricultural information across all target areas and beyond at 5 year intervals. Each census produces a snapshot of Canadian agriculture by providing statistics at national, provincial, and sub-provincial levels on such topics as crop type and areas, numbers of livestock, soil conservation practices, natural land areas, conservation type crops and area, and land management practices. Censuses have been completed in 1986, 1991, and 1996. At the sub-provincial level, data is typically aggregated within consolidated census subdivision (CCS) boundaries. This CCS role-up was too coarse however for use as a monitoring tool for targeted areas. Working with statistics Canada, we developed a method whereby enumeration areas (EA's: the smallest geographic unit currently accessible for use) were used to evaluate changes in NAWMP targeted areas and non-targeted areas within the PHJV delivery area. EA boundaries were used to rebuild targeted areas, although the match to targeted areas was not exact (with the exception of Manitoba target areas which matched EAs exactly). EA representations of target areas were created with the aid of other data sources such as Ducks Unlimited Canada Priority areas (Kazmerik 2001). The resulting geographic units were the best product possible to evaluate total landscape change within targeted areas using agricultural census data.

We acquired all agricultural statistics for the 1986, 1991, and 1996 census for the EA defined target areas within the PHJV delivery boundary. We also acquired data for non-target areas for the purpose of comparison to targeted area results. Non-target area EAs were rolled up to the ecogregion level (Figure 11). This data was analyzed and incorporated into a GIS that provided information regarding changes in area, and numbers of farms reporting for specific variables (refer to Appendix III). EA boundaries have changed slightly over the years and thus Statistics Canada was contracted to perform the appropriate data assembly based on the geographies defined through EA conglomeration.

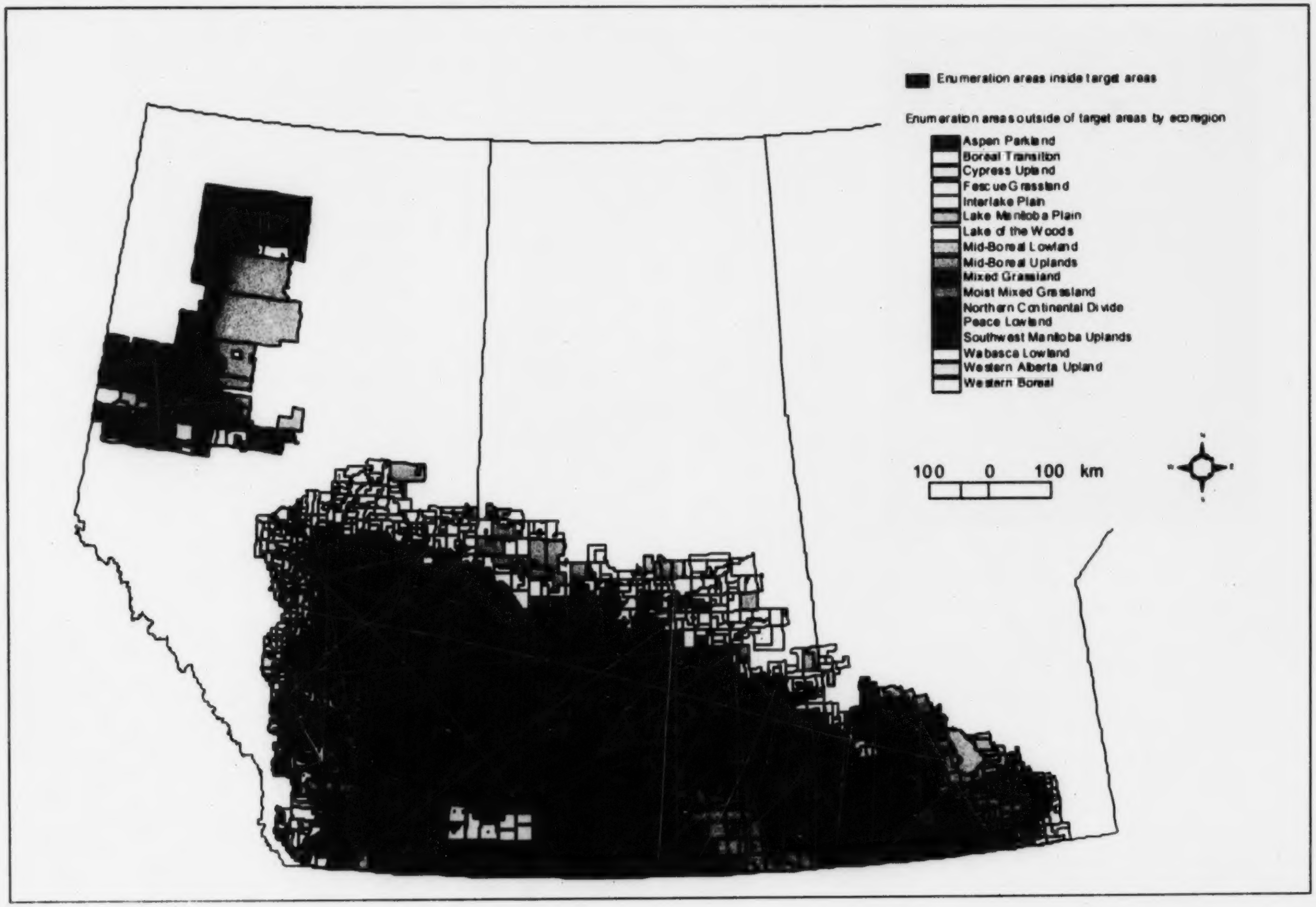
Enumeration areas inside target areas
Enumeration areas outside of target areas by ecoregion
Aspen Parkland
Boreal Transition
Cypress Upland
Fescue Grassland
Interlake Plain
Lake Manitoba Plain
Lake of the Woods
Mid-Boreal Lowland
Mid-Boreal Uplands
Mixed Grassland
Moist Mixed Grassland
Northern Continental Divide
Peace Lowland
Southwest Manitoba Uplands
Wabasca Lowland
Western Alberta Upland
Western Boreal
100 0 100 km

Figure 11. Overview of AG Census data amalgamations by target and non-target area.

Figure 12 demonstrates how AG census target area geographies were created using PHJV target areas, and DU priority polygons during the decision process. Note that target areas did not match up exactly to EA boundaries and it was necessary to ensure that only EAs most likely to represent targeted area activities were included for target area analysis.

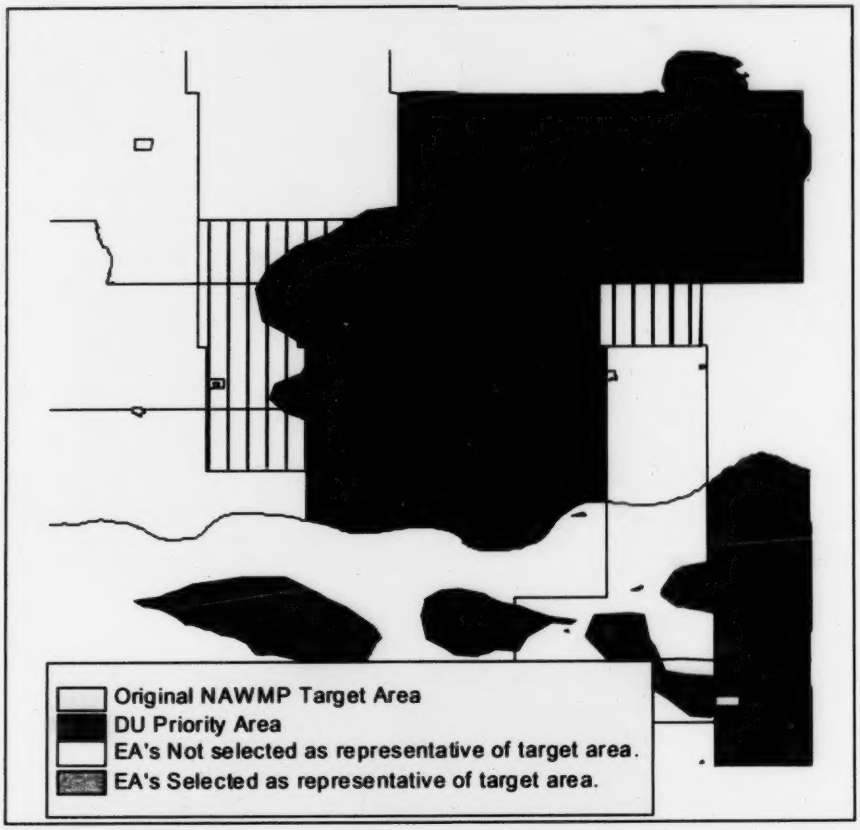
Original NAWMP Target Area
DU Priority Area
EA's Not selected as representative of target area.
EA's Selected as representative of target area.

Figure 12. Example of EA selection process for mimicking targeted areas for AG census change detection.

The agricultural census data is used to provide some insight as to what is happening across targeted landscapes. The data is reported to complement transect results and provides broad scale upland information for comparison to the smaller sample of the transect. The agricultural census data does not provide any information regarding wetlands.

Percentage change was derived from the difference between the 1985 dataset and the 1996 dataset, divided by the 1985 value. The 1991 data was only used to report change for some variables that were not surveyed in 1985 but were present in 1991. Some modifications of variables were necessary to maintain consistency in reporting the different years census results. Comprehensive Agricultural Census data is reported for targeted and non-targeted areas, by province, ecoregion, and PHJV area in Appendix III.

Results and Discussion

Sample Size

Overall, a total of 56 transects were surveyed within the PHJV landscape, encompassing 1304 quarter sections (86,939 ha). The total area sampled comprised 0.15 % of the entire PHJV landscape and 0.63 % of the NAWMP target areas. Table 4 provides a breakdown of sample distribution across the PHJV landscape.

	Landscape	*# of Transects Sampled*	*% of Total PHJV[2] Area (within specified landscape) Sampled*	*% of Total Target[1,2] Areas (within specified landscape) Sampled*
Overall	**PHJV**	56	0.15 %	0.63 %
Ecoregion	**Grasslands**	27	0.16 %	0.58 %
	Parkland/Boreal Transition	29	0.14 %	0.67 %
Provincial	**Alberta**	32	0.24 %	0.64 %
	Saskatchewan	20	0.11 %	0.59 %
	Manitoba	4	0.08 %	0.75 %

[1] *All transects area not completely within target area boundaries were considered as sample from entire target area.*

[2] *Excludes the Peace River Grand Prairie region of Alberta..*

Table 4. Sample distribution by landscape, and percentage of total PHJV and Target areas sampled.

Wetlands

Water Levels

Water levels can have great influence on wetland habitat change detection work. Pond estimates were high for the baseline data from 1985 as illustrated by the pond count from the annual waterfowl surveys (USFWS 2001) which estimated "May Ponds" for prairie Canada to be 4.3 million, compared to the average pond count of 3.4 million ponds (1961-2000). Thus the 1985 habitat monitoring transects provided excellent baseline from which future comparisons can be made against because the good wetland conditions greatly facilitated delineation of wetland basins. In 1999 May ponds on the Canadian Prairies equaled 3.9 million ponds again a fairly wet year which helped to ensure accurate field data updating.

Change detection through air photo comparison can be greatly influenced by differences in water levels and could provide unreliable change information if water levels between survey years were significantly different. Because new air photos were not used for the 1999 update, water levels were not a major influence on habitat change detection in this study. The ground-truthing methodology required observers to check the physical depression in the ground that formed wetland basins and thus not rely on water levels as an indication of wetland presence or absence. Water fluctuations did not constitute a basin polygon change. Only physical change of the basin would result in a polygon boundary change.

Gross Wetland Loss

Gross wetland losses report total lost wetland area and is considered the most accurate measure of wetland change in this project because wetland gains were usually wetland types with low wildlife habitat value.

Gross wetland loss for the sample (n=56 transects) from 1985 to 1999 was 3.7 %, a reduction in wetland area of 337.3 ha from the 9231 ha existing in 1985. Wetland losses were highly variable, with gross losses ranging from 0 – 50 % on various transects. Average gross loss of wetland hectares per transect was 6.0 ha (SD = 7.2). Gross wetland loss by Ecoregion and Province are shown in Table 5.

	Landscape	*# Transects*	*Wetland ha Lost*	*% Wetland Area Lost*	*Mean Loss per Transect*	*Standard Deviation*
Overall	PHJV	56	-337.3	-3.7 %	-4.9 %	8.0
Ecoregion	Grassland	27	-132.5	-4.2 %	-6.4 %	10.9
	Parkland Boreal Transition	29	-204.8	-3.4 %	-3.5 %	3.2
Province	Alberta	32	-179.2	-4.4 %	-6.0 %	9.3
	Saskatchewan	20	-108.0	-3.0 %	-3.0 %	5.9
	Manitoba	4	-50.1	-4.9 %	-5.4 %	4.0

Table 5. Gross wetland loss by landscape region.

The mean size of the lost wetland basin area was 0.24 ha (SD = 0.5), this area represents entire wetland basins or a portion thereof. The average size of wetlands affected by wetland losses (wetlands having total basin removed or wetlands impacted through partial basin destruction) equaled 0.67 ha (SD = 2.4). The average size of complete basins lost was 0.27 ha (SD = 0.5).

Most wetland area loss was of the grass and sedge basin type accounting for 56.1 % (185.56 ha) of the total wetland area losses. Cultivated, deep marsh, and wooded wetland basins losses equaled 26.6 %, 4.3 %, and 7.2 % of the total lost wetland area, respectively (Figure 13).

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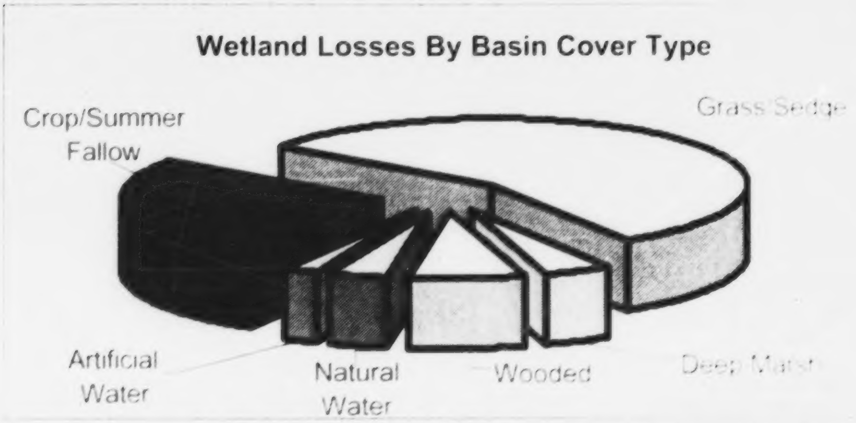


Figure 13. Percent composition of total gross lost wetland area by cover type.

Most wetland basins lost had no perceived basin activity in 1985 comprising 42.3% of the total lost wetland area. Cultivated and grazed basins (activity prior to loss) made up 26.4% and 18.2% of the total lost wetland area. Hayed basins made up 5.4% of the lost wetland area.

Attributing Gross Wetland Losses

Agricultural activities such as expansion of cultivated area, repeated cultivation of basins, filling and squaring of the field accounted for the majority (67.0%) of all lost wetland area (Figure 13). Rural development including road expansion, town site expansion, and agricultural infrastructure expansion caused 10% of the lost wetland area. The other 22.7% of the lost wetland area was caused by a variety of activities.

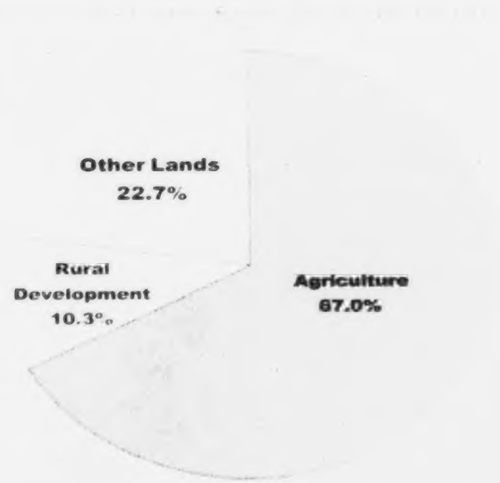
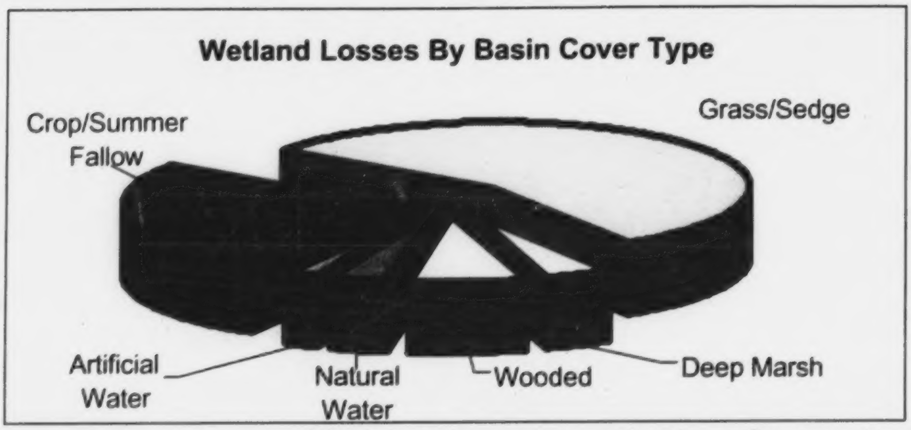


Figure 14. Upland classification replacing wetland area lost from 1985 to 1999



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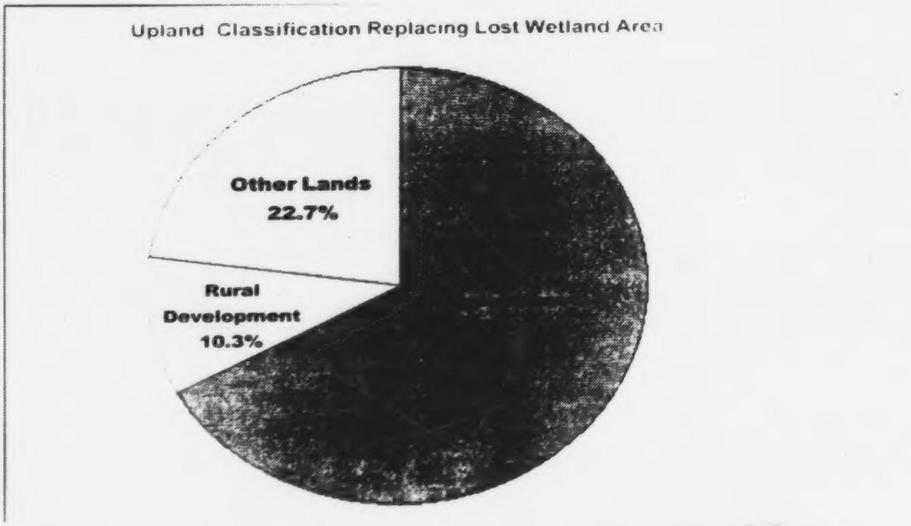

Figure 14. Upland classification replacing wetland area lost from 1985 to 1999.

Gross wetland loss suggests that cultivated basins are the most vulnerable to basin destruction. The cultivated basin type accounted for 13 % of the total area of wetlands in 1985, and accounted for 27 % of the total gross wetland area lost. Dahl (2000) referred to the small size of emergent wetlands (emergent wetlands are similar to the grass and sedge wetlands of this project) making this category of wetland susceptible to loss. These wetlands are often eliminated through various measures such as surface ditching, filling, diverting water inflows, or disrupting the confining soil layer. Small isolated wetlands appear especially vulnerable in a cultivated setting as these basins are often avoided during wet periods, but in dry times these basins may be tilled. Grass and sedge basins in cultivated settings are also subjected to multiple uses. It is not uncommon to cultivate to the margins of these wetlands in the spring and hay the actual basin in the fall. Destruction of wetlands through drainage was recorded for a few larger wetlands which were more permanent (natural open water cover type) in nature. Drainage networks were utilized to reduce basin area, or completely drain a basin. Drained basins were only recorded as losses if the basin was destroyed through permanent conversion to an upland or infrastructure cover type. Losses in the permanent and deep marsh habitat categories were often the result of basin reduction rather then complete basin destruction.

Wetlands that were encroached by cultivated uplands in 1985 accounted for over 70 % of all wetland losses (Figure 15).

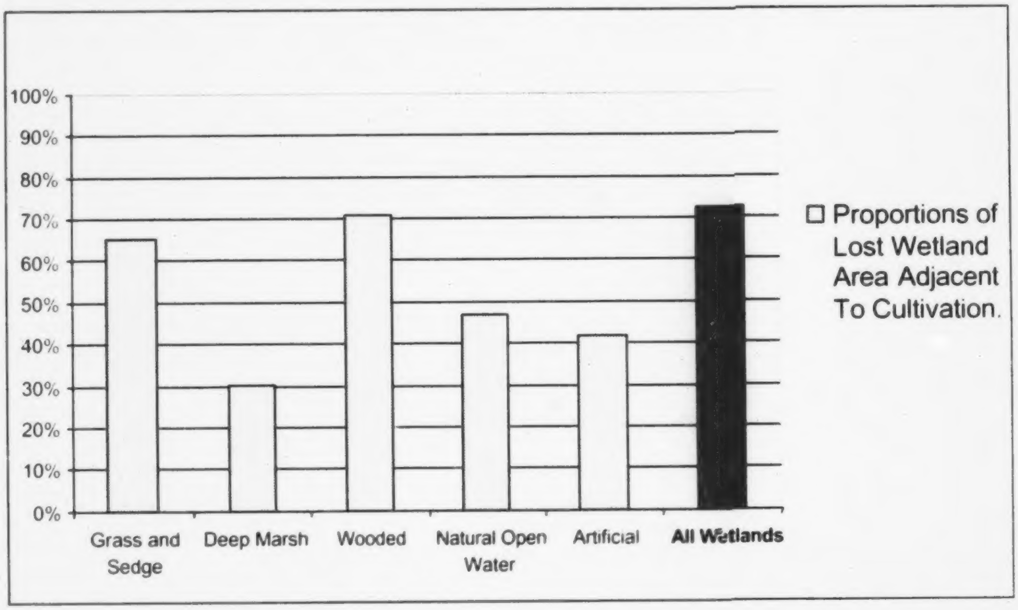

Figure 15. Proportions of lost wetland area (determined in 1999) within or immediately adjacent to cultivation in 1985.

Attributing Gross Wetland Gains

Wetland gains are actual gains in wetland area (natural and non-natural) that occurred between the baseline data collection and the 1999 survey. Gains were recorded where wetland area replaced an upland category. It is important to note that gains in wetland area were not always the result of direct human intervention; some of the gains were the result of basin expansion due to natural conditions. The gains information presented in this section is gross wetland gains.

Overall, 78.1 hectares of wetlands habitat were added to the 1999 dataset. The largest wetland gains were the result of basin expansion which accounted for 38 % of the total wetland area gains. Dugouts, new drainage construction, and new basins accounted for 12 %, 36 %, and 14 % of the total wetland area gained, respectively (Figure 16)

Basin expansion wetland gains were largely attributed to basin expansion due to water diversion or drainage from surrounding basins, and damming of wetlands creating larger back water areas.

Artificial wetland gains were the result of irrigation expansion and a large increase in the number of dugouts. Dugouts, canals and reservoirs were often situated in areas of naturally occurring wetlands and would not always be considered gains as they replaced existing wetland area with a new cover type.

New cultivated basins were sometimes created through the removal of isolated wooded upland type habitats in cultivated fields, which resulted in the creation of shallow depressions capable of holding water for a short period of time.

The creation of new drainage channels also resulted in gains in wetland area. Ditches created for drainage constituted new wetland areas and were recorded as a wetland area gain. Drainage ditches were not considered as irreversible impacts and thus the original basin being drained was typically degraded rather than destroyed. Drained basins and the associated ditches hold water for a short duration and therefore were considered as wetlands.

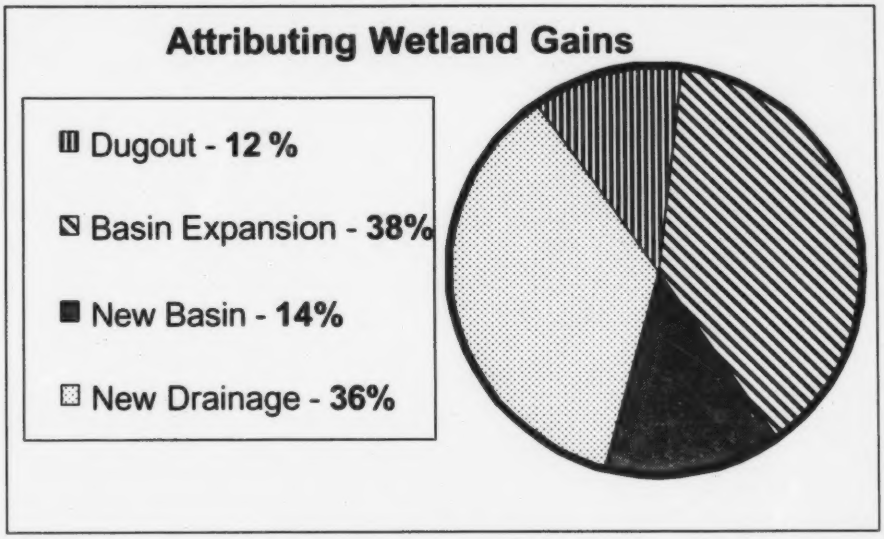

Figure 16. Attributing wetland gains in the Prairie Habitat Joint Venture Study area.

A total of 6.1 ha 7.9% of all wetland gains was attributed to NAWMP intensive program delivery on the sampled landscape (DU intensive quarter section data provided by Ducks Unlimited Canada, B. Kazmerik, 2000). Gains on intensive areas were made up of 55 % open water/deep marsh habitat, 42 % grass and sedge, and the remaining 2 % as other cover types. The gains in open water/deep marsh habitat on DU intensive quarters accounted for 46 % of the total wetland gains for these cover types. The open water gains were the result of water management programs which did result in expanded basin area.

Wetland gains in the PHJV study area were not sufficient in area or composition to offset overall wetland losses. The majority of wetland gains were the result of basin expansion, basin consolidation and new drainage. Although the exact cause of the basin expansion was not always clear, the majority of wetland area gains appeared to be at the expense of other basins. Inter-basin drainage was noted as a means of draining one or several basins and consolidation into an expanded basin, which turned previously upland (low prairie type areas) into wetland. The functionality of new basins such as dugouts, irrigation canals, and reservoirs as productive wildlife habitats cannot always be considered comparable to natural occurring wetlands.

Net Wetland Area Change

Net wetland change reports the overall change in total wetland area with gains and losses combined.

The areas defined as gross wetland gains were combined with the gross wetland losses to arrive at the net wetland area change presented here. Net loss of wetland area was 2.8 % and net loss of wetland numbers was 4.0 % (A Net total of 935 wetlands totaling 258.8 ha were lost from 56 transects). The net loss of wetland area was highly variable across the sampled landscapes, with changes per transect ranging from -50 % (28.9 ha) to +12 % (5.9 ha). The average net loss of wetland hectares per transect was – 4.6 ha (SD = 6.3) from a mean total transect area of 1552.4 ha. Table 6 below summarizes net wetland loss by landscape region.

	Landscape	*# Transects*	*Wetland ha Lost*	*% Wetland Area Lost*	*Mean Loss per Transect*	*Standard Deviation*
Overall	PHJV	56	-258.8	-2.8 %	-3.9 %	8.0
Ecoregion	Grassland	27	-104.1	-3.3 %	-4.2 %	7.6
	Parkland/Boreal Transition	29	-154.7	-2.6 %	-2.7 %	2.6
Province	Alberta	32	-142.6	-3.5 %	-4.9 %	9.6
	Saskatchewan	20	-86.0	-2.1 %	-2.4 %	5.3
	Manitoba	4	-30.3	-3.0 %	-3.0 %	2.4

Table 6. Net wetland area loss by landscape region.

The Grasslands landscape of the PHJV suffered slightly higher net percentage wetland loss than the Parkland/Boreal Transition landscape. The lower density of wetlands in the surveyed portions of the Grasslands resulted in lost wetland area having a more pronounced effect on the net percentage change numbers for this landscape.

Provincially, Alberta suffered higher net percentage wetland loss than Saskatchewan or Manitoba. Alberta was sampled with slightly higher intensity than the other provinces, but the proportions of sampled targeted area was comparable to that of the other provinces. A significant number of sampled transects in Alberta were located in the Grasslands (low wetland density areas), and thus, small losses in wetland area resulted in significant net percentage loss numbers. Target areas in southern Alberta are also less wetland focused then those of Saskatchewan and Manitoba and thus land which is more suitable for agricultural was included in the Alberta sample, thus samples in these areas may have resulted in a higher area of wetland loss for Alberta. The provincial differences may also be explained by the rapid economic development occurring within Alberta.

Wetland Cover Type Change

Cover change data summarizes changes of wetland cover types from one category to another and incorporates cover type area lost to basin destruction. This data incorporates all wetland gains and losses presented in previous sections and thus provides information regarding the overall change in wetland cover composition between 1985 and 1999. The basin cover type describes the dominant cover type for the wetland basin. Figure 16 below compares the composition of wetland cover types for all sampled wetlands from 1985 and 1999 surveys.

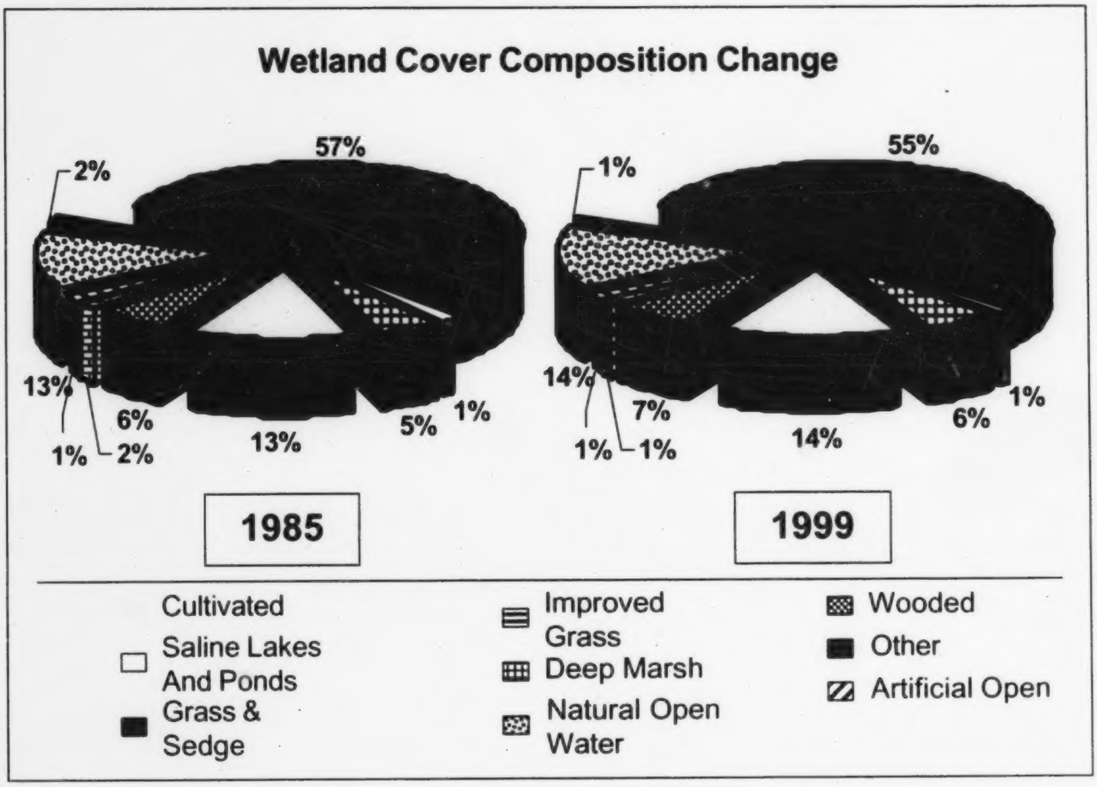

Figure 17. Wetland cover composition change for the sampled transects from 1985 to 1999.

A total of 23,293 wetlands covering an area of 9231 ha were surveyed as part of the 1985 baseline. Grass and sedge or shallow marsh type wetlands were the most prevalent wetland basin cover type at 57 % of the wetland baseline area. As a result of wetland

losses and shifts to other cover types, Grass and Sedge wetlands showed the largest reduction in area from 1985 to 1999. Saline lakes and ponds also showed significant reductions; these areas went from open water type habitat to deep marsh habitat dominated by emergent vegetation. Cultivated wetland basins area increased from 1985 to 1989.

The size of wetlands may have been a limiting factor when considering basin destruction. Table 7 below provides a breakdown of the mean sizes of wetlands for the sampled transects as a comparison to the mean size of lost wetland basins.

Wetland Cover Type	Mean Size of Lost Basins (ha)	Mean Size[1] 1985(ha)	Mean Size[1] 1999(ha)	Range 1985(ha)	Range[2] 1999(ha)
Grass and Sedge	0.312	0.409	0.417	<1 – 23.623	<1 – 23.623
Cultivated Cover	0.211	0.211	0.231	<1 – 31.459	<1 – 44.199
Open Water	0.422	1.483	1.333	<1 – 43.885	<1 – 45.335
Deep Marsh	0.447	0.658	0.609	<1 – 44.113	<1 – 22.879
Artificial Water	0.120	0.282	0.287	<1 – 6.630	<1 – 5.074

[1] *The mean size is calculated from individual polygons, thus multi-polygon wetlands are not combined.*
[2] *The maximum limit of the wetland cover type area is restricted by the plot size.*

Table 7. A comparison of mean wetland cover and range sizes as present in 1985 and 1999, compared to the mean size of lost wetland basins.

In 1985, a total of 59 % (Figure 17) of all wetlands area was located in or within 5m of cultivated uplands, and in 1999 this total dropped to 56 %. Wetlands located within or immediately adjacent to cultivation are potentially affected by herbicide and pesticide applications, irrigation activities, soil erosion and deposition (Dahl 2000).

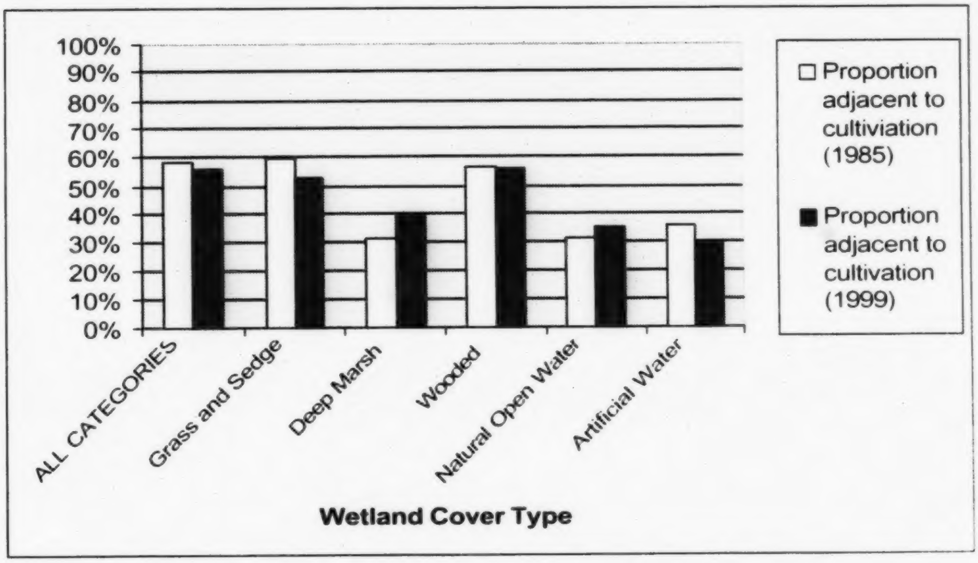

Figure 18. Proportion of wetland polygons area within or adjacent to cultivation.

An example of a large area shift in wetland cover type is shown in Figure 19 below. The photo time series shown below demonstrates the changing cover types for an individual losses and shifts to other cover types, Grass and Sedge wetlands showed the largest reduction in area from 1985 to 1999. Saline lakes and ponds also showed significant reductions; these areas went from open water type habitat to deep marsh habitat dominated by emergent vegetation. Cultivated wetland basins area increased from 1985 to 1989.

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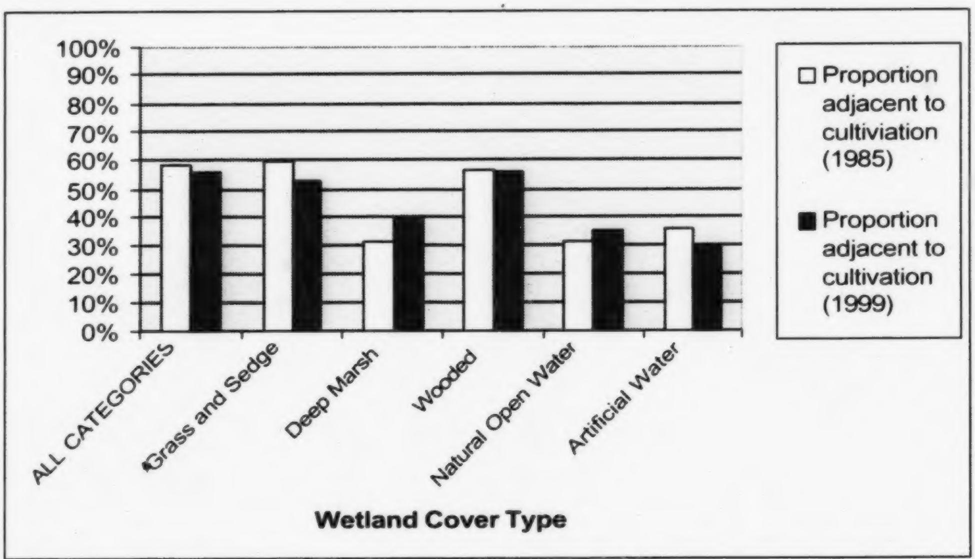

Figure 18. Proportion of wetland polygons area within or adjacent to cultivation.

An example of a large area shift in wetland cover type is shown in Figure 19 below. The photo time series shown below demonstrates the changing cover types for an individual wetland basin. In 1949 this wetland was dominated by emergent vegetation, 1969 shows more open water habitat, 1985 basin cover class was recorded as Natural Open Water habitat, and in 1998 this basin was dry and entirely cultivated, in 1999 the basin was reclassified to a cultivated basin. This basin was not considered to be destroyed but rather received a degraded cover code.

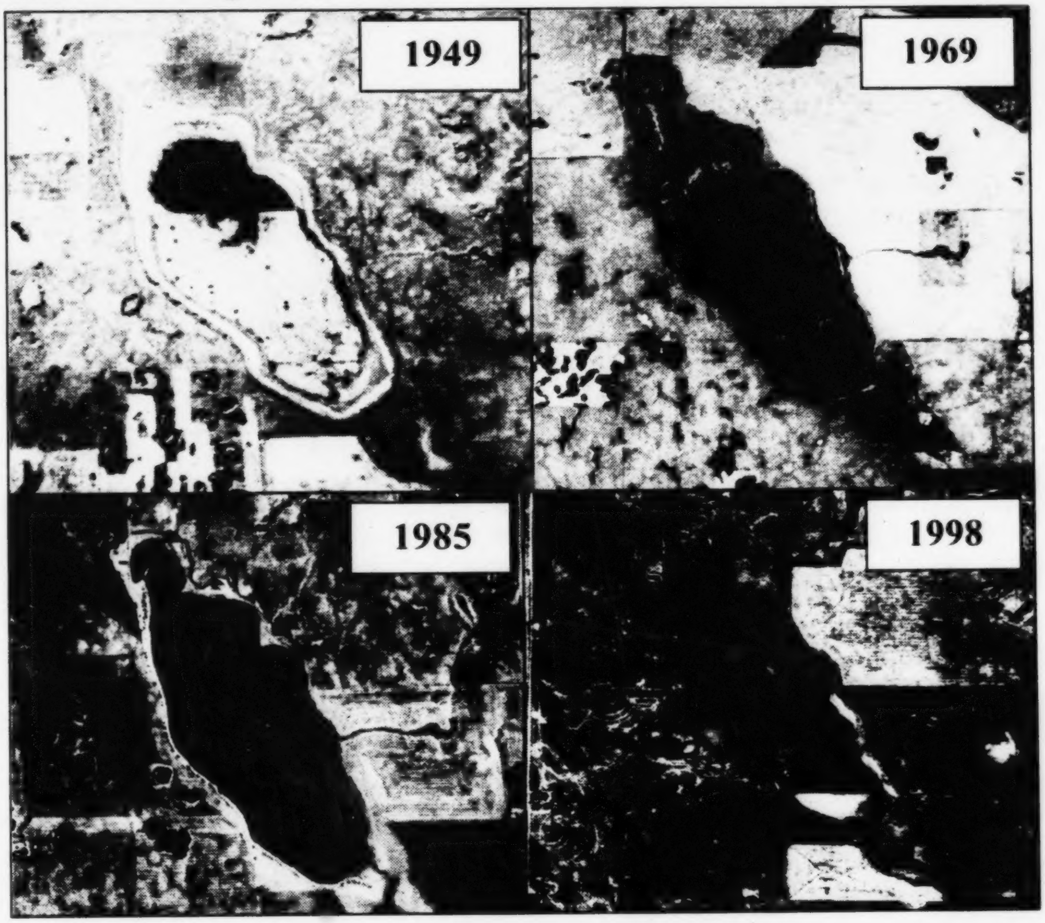

Figure 19. An example of a wetland cover shift through time.

The grass and sedge category saw the biggest decline in area with a reduction of -9.0 % from the baseline area (Table 8). Saline lakes and ponds also decreased 35.4 % from the baseline area, the result of deep marsh vegetation becoming the dominant cover type for the majority of this area. Artificial open water made up primarily of dugouts and reservoirs increased by 5.5 %. Wetland cover change for the various landscapes of the PHJV is reported in Table 9.

PHJV Area n = 56 Transects	Cultivated	Improved Grass	Wooded	Grass & Sedges	Bulrush/ Cattail	Saline Lakes and Ponds	Natural Open Water	Artificial Open Water	Other
85 – 99 Total Change in Hectares	75.3	57.8	71.3	-477.4	102.5	-65.2	-8.5	6.0	-20.9
% Change from 85 baseline	6.2%	82.1%	13.8%	-9.0%	21.4%	-35.4%	-0.7%	5.5%	-13.7%
Mean (ha) Change	1.3	1.0	1.3	-8.5	1.8	-1.2	-0.2	0.1	-0.4
Standard Deviation (ha)	12.5	6.6	4.2	13.7	9.0	6.6	11.2	1.3	2.9

Table 8. Wetland cover type change data for all surveyed transects (n=56).

	Landscape	Cultivated	Improved Grass	Wooded	Grass & Sedges	Bulrush/ Cattail	Saline Lakes and Ponds	Natural Open Water	Artificial Open Water	Other
Ecoregion	Grassland	-18.2% -77.1 ha	306.6% 24.5 ha	8.6% 7.2 ha	-4.6% -88.9 ha	-4.4% -6.5 ha	-17.1% -22.8 ha	15.9% 47.8 ha	8.5% 4.6 ha	9.8% 6.9 ha
	Parkland/Boreal Transition	19.2% 152.4 ha	53.3% 33.3 ha	14.8% 64.2 ha	-11.7% -388.6 ha	33.0% 109.0 ha	-83.9% -42.4 ha	-6.1% -56.3 ha	2.6% 1.4 ha	-33.7% -27.7 ha
Province	Alberta	5.3% 27.4 ha	44.2% 27.7 ha	-2.3% -4.8 ha	-6.2% -135.3 ha	38.9% 73.0 ha	-76.4% -67.0 ha	-10.6% -72.4 ha	25.3% 15.7 ha	-8.8% -6.9 ha
	Saskatchewan	7.9% 48.7 ha	316.5% 22.0 ha	24.9% 58.6 ha	-11.3% -268.8 ha	7.6% 14.9 ha	2.1% 1.9 ha	11.8% 59.2 ha	-22.2% -9.6 ha	-18.4% -13.2 ha
	Manitoba	-1.0% -0.8 ha	1161.5% 8.1 ha	24.9% 17.5 ha	-10.2% -73.4 ha	15.7% 14.5 ha	0.0% 0.0 ha	13.1% 4.7 ha	-1.3% -0.1 ha	-30.2% -0.8 ha

Table 9. Absolute wetland cover type change data breakout for selected landscapes.

Changes in wetland cover included both human induced and natural changes. Cover shifts can be attributed to changes in dominant cover types for wetland basins as well as basin destruction resulting in a replacement of wetland cover by an upland cover type. Basin cover type data shows that overall natural wetland habitat has been reduced. The grass and sedge type wetland is the most significantly impacted cover type. Small, grass and sedge type wetlands are vulnerable to many impacts as these wetlands are often dry for a significant portion of the year and thus it is more likely that they may become degraded by human activities. The grass and sedge type wetland is the most prevalent wetland type measured; it is this abundance that also makes it susceptible to impacts as it is a common obstacle on the landscape.

Figure 19. An example of a wetland cover impact.

Wetland Activity Type Change

Wetland basin activity reports actual activities within wetland basins. Shifts in wetland activity includes the result of wetland basins lost and the change in land use activity associated with wetlands. The classification of activity impacting wetlands was a point in time measurement and thus provides only an indication of the activity at the time of the survey. Wetland basin area with No activity increased by 3.9 % (Figure 20). The increase in no activity was largely as a result of increased water levels in some basins which limited land use activity. Due to the early spring timing of the ground survey it was difficult to determine if a basin would be grazed so the methodology focused on classifying grazed basins only if there was evidence of grazing at the time of survey or in the previous year. Impacts such as grazing may vary substantially from year to year dependent upon water conditions and thus changes may not be indicative of long-term trends.

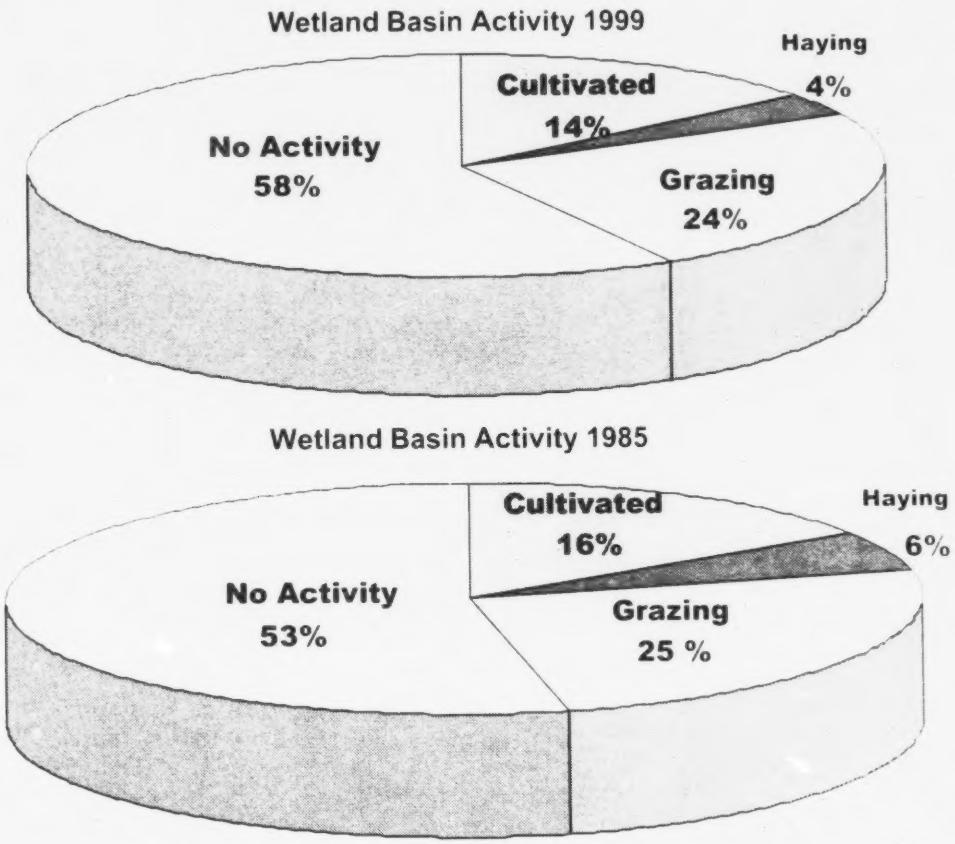

Figure 21. Wetland basin activity change 1985 and 1999 datasets.

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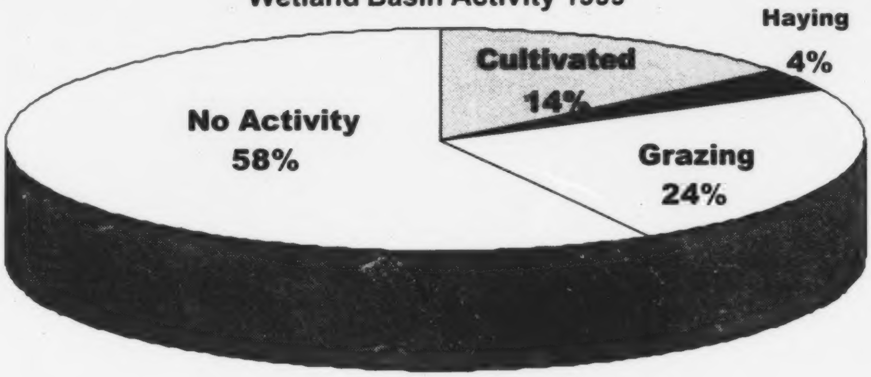
Wetland Basin Activity 1999



Wetland Basin Activity 1985

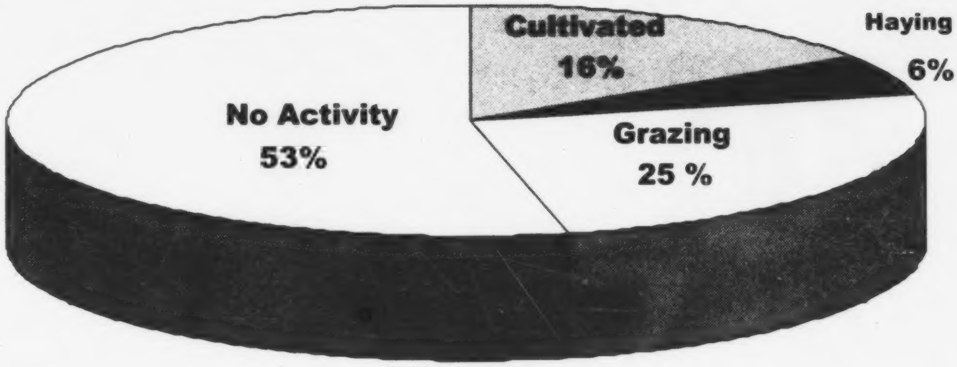


Figure 21. Wetland basin activity change 1985 and 1999 datasets.

Wetland Habitat Change Summary

Gross wetland area loss within the PHJV target areas between the years 1985 to 1999 is estimated to be -3.7 % or 53,492 +/- 16,850 ha of the estimated 1.43 million +/- 190,000 ha of wetlands.

Net wetland area and numbers within PHJV targeted lands have declined since 1985. Net results show a 4.0 % decrease in wetland numbers and a 2.8 % decrease in wetland area between the years 1985 and 1999. Shifts of wetland cover type have also occurred due to natural and non-natural causes. Grass and sedge basins decreased from 57 % to 55 % from 1985 to 1999, whereas cultivated basins increased from 13 % to 14 % of total wetland area.

PHJV activities within the NAWMP targeted areas have not been of sufficient magnitude to completely halt the continuing loss of wetlands. Whether PHJV activities resulted in relatively less wetland loss than in areas not targeted by PHJV activities is difficult to discern because comparable data regarding losses outside of target areas was not collected. Nevertheless, it is reasonable to assume that the management activities of the PHJV have had a measured positive impact barring some compensatory types of wetland destruction activities.

It is difficult to relate this study to other studies due to differences in time periods, classification schemes, methods, localized geographic influences, and definitions of wetland loss. The following section looks at the findings of some prominent studies on the Canadian Prairies for the purposes of comparing findings, and providing some insight as to how the PHJV may have influenced wetland conservation.

The USFWS Status and Trends of Wetlands program which uses a similar methodology to the PHJV transects estimated that between the years 1986 and 1997 freshwater emergent type (this type of wetland is considered the most comparable type of wetland to the wetlands measured in this report with the exclusion of the open water habitats) declined - 4.6 % (Dahl, 2000). Fresh water pond habitats area, which are considered equivalent to the various open water cover types, were estimated to increase by 13 %. The USFWS estimated that freshwater emergent wetland losses were attributed to 25 % urban and rural development, agricultural 51 %, upland forestry 2 %, and miscellaneous lands 25 %. In total, the USFWS estimated that the freshwater wetlands accounted for 98% of all estimated wetland losses from 1986 – 1997 (Dahl, 2000).

Ignatiuk and Duncan (1995) examined the numbers of wetlands lost in Saskatchewan's NAWMP target areas using aerial photography between 1947 1949 and 1986 - 1992. They reported a mean permanent wetland loss (in numbers of wetlands) of 6 % with high geographic variability. Although wetland numbers were not the primary focus of the current study, the 2.0 % reduction in the numbers of wetlands in Saskatchewan between the years 1985 and 1999 for the sampled NAWMP target areas is very similar to the loss rates found when the different lengths of time for the two studies are taken into account. The annual rate of wetland numbers lost over the 41 year period examined by Ignatiuk and Duncan was -0.15% and for the PHJV transects in Saskatchewan from this study was -0.14% over the 14 year period. This comparison shows very comparable rates of wetland loss in Saskatchewan between the two studies, and suggests loss rates have not ameliorated in recent times with the advent of PHJV activities.

Goodman and Pryor (1972) reported a 13 % decline in wetland area and - 4.5 % decrease in wetlands numbers for the black soil zone of the Prairie Provinces between the years of 1940 and 1970. The annual rate of loss calculated over the 30 year period for the Goodman and Pryor study was - 0.15% for wetland numbers, and - 0.43% for wetland area. The PHJV transects in this study had similar results with - 0.19 % annual loss in wetland numbers but, a significantly lower rate of- 0.17 % annual loss for wetland area. Differences in loss of wetland area could be the result of differing methods for defining wetland area, definitions of wetland loss, changes in wetland size distribution or could be as the result of reduced wetland area loss in recent years due to PHJV activities. The difference between the wetland loss numbers may be the result of minimum mapping units, time periods, or definitions of wetland loss. This comparison does suggest that smaller wetlands of less area in the black soil zone of the prairie provinces are being lost at a faster rate then in previous years, but due to the different methods this can not be stated with great certainty.

Turner et al. (1987) examined drainage rates (comparable to basin destruction, but excluding filling) for the three prairie provinces and found the annual rate of loss from 1981 to 1985 to be: Saskatchewan 0.19 %, Manitoba 0.25 % and Alberta 0.53 % and a mean annual rate of 0.32 % for all three provinces. In comparison with the current study drainage rates for each province report similar trends. The PHJV monitoring transects report annual net loss (wetland numbers) rates as follows: Saskatchewan 0.24 %, Manitoba 0.32 % and Alberta 0.48 % and a mean annual rate of 0.35 %. Both studies suggest that wetland loss is highest in Alberta and lowest in Saskatchewan. Turner et al. also found that drainage rates in the USA were also higher then those reported in Canada, similar to the findings of the PHJV transect work when compared to the USFWS wetland trend analysis work. The drainage rate reported by Turner et al. is not directly comparable to the wetland loss rate reported by the PHJV transects. However, considering the differences in the two methods, the annual rates of loss reported appear fairly similar if one included permanent drainage as a component of permanent wetland loss under the PHJV transect methodology.

Other studies conducted in Prairie Canada have focused on small geographic areas and appear to pick up on what can be considered "Hot Spot" areas for wetland loss. The smaller study areas tend to report higher wetland loss values, whereas studies looking at broader landscapes report smaller wetland losses but significant spatial variation. An example of a "Hot Spot" type area was documented by Rakowski et al. (1974) who examined wetland loss in the Minnedosa Pothole Region of Manitoba between the years of 1964 and 1974 and found a decline in wetland area of -41 %. This study appears to provide an example of localized effects that may show dramatic losses of wetland habitat. The PHJV transect analysis also documented localized "Hot Spot" transects with the highest reported wetland loss of – 50 %.

Annual information from the annual Canadian Wildlife Service Air Grounds data also reports fluctuating impacts on wetland basins and provides insight as to the health of wetlands habitats on an annual basis. Turner et al. (1987), examined annually surveyed air ground transects for types and frequencies of agricultural impacts on wetland basins and margins. During that study, 10,000 potential wetlands were monitored annually from 1981 – 1985. The study found that agricultural impacts on basins in the grasslands averaged a 62.6 % and parklands averaged 56.2 % over the five year time period. In 1985 the transect data showed agricultural impacts on 61 % and 59 % of the surveyed basins in the grasslands and parklands respectively. In 1999 agricultural impacts from this study were recorded for 50 % and 37 % of the wetland basins in the grasslands and parklands respectively. The year 1985 had favorable conditions for wetlands as water levels were high (Turner et al. 1987) thus agricultural impacts on wetlands were slightly reduced. The reduction of the number of wetland basins directly impacted by agriculture in 1999 is a positive trend, and may be the result of conservation efforts, or more likely is a result of differing methodologies between the two studies. However, wetland basin impaction is something that should be viewed as an annually fluctuating measure and appears closely related to water levels within basins.

Previous studies regarding wetland loss for the Prairie Provinces report a range of wetland loss values. Considering findings from this study and past studies on the Canadian prairies it can be concluded that wetland loss is highly variable across the landscape and that quantities of wetlands area impacted fluctuates over time. The data in this study and other studies document a slow but continuing rate of wetland loss, emphasized by some dramatic wetland losses in localized areas. Evidence for PHJV influences regarding wetland losses is not clear. The comparison of datasets suggests there has been none to little change in the rates of wetland area and numbers loss over the last few decades. Wetland losses may be related to land operator attitudes, the capability of localized areas to support specific agricultural activities detrimental to wetlands, land ownership changes, economic shifts and attrition of small wetlands which are continually impacted by agricultural activities.

Uplands Habitats

Upland habitat data presented reports trends from 2 sources: PHJV habitat monitoring transects surveyed in 1985 and 1999, and data from the 1986 and 1996 Census of Agriculture analyzed by targeted and non-targeted NAWMP landscapes within the PHJV delivery area. Census data is incorporated into appropriate cover trends, and is intended to provide a "big picture" look at trends in targeted landscapes and provide comparative information between targeted and non-targeted landscapes.

Upland Cover Change

A total of 77,702 ha of uplands habitats were surveyed in 1985 on the PHJV transects (n=56). Agricultural Census information provides data for 37,126,363 ha of non-targeted and 15,671,872 ha of targeted landscapes.

Habitat Monitoring Transects Upland Results

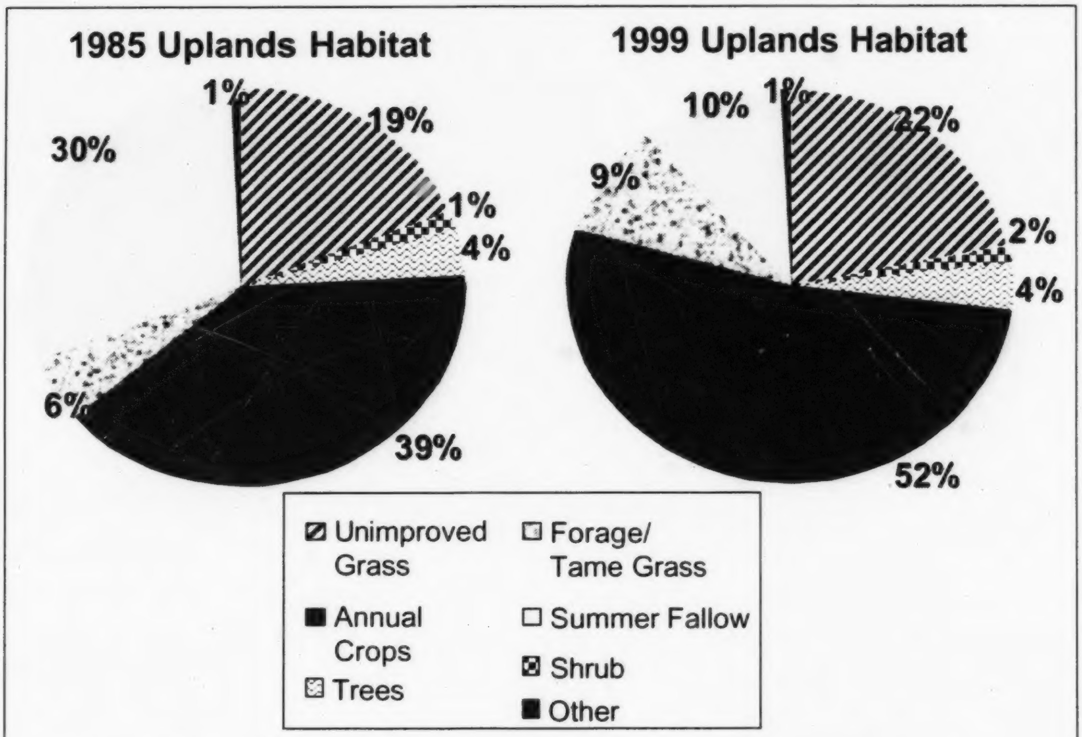
Total cultivated area (summerfallow and annual crops combined) has declined 9.1 % (-4932.9 ha) from the 1985 baseline cultivated area on the 56 habitat monitoring transects. Tame grass and tame pasture combined increased 62.6 % (2708.9 ha) from 1985 to 1999. Unimproved grassland area increased 16.2 % (2367.9 ha). Shrub cover increased 4.5 % (51.9 ha), and treed habitat decreased -2.5 % (-74.9 ha). Rural infrastructure development increased by 10.9 % (332.8 ha). A summary of the trends for the major upland habitat types, by various landscape is presented in (Table 10) below.

	Landscape	Cultivated	Summerfallow	Annual Crops	Unimproved Grass	Tame Hay/Grass	Shrubs	Trees	Other
Overall	PHJV	-9.1 % -4932 ha	-65.7 % -15293 ha	33.6 % 10360.9 ha	16.23 % 2368 ha	62.6 % 2709 ha	4.5 % 52 ha	-2.5 % -75 ha	12.4 % 74 ha
Ecoregion	Grassland	-9.1% -2221 ha	-37.4 % -3486 ha	8.4% 1264 ha	10.0 % 992 ha	49.1 % 1122 ha	3.4 % 16 ha	52.4% 61 ha	42.9% 91 ha
	Parkland/Boreal Transition	-9.1 % -2711 ha	-84.6% -11808 ha	58.0 % 9097 ha	29.5% 1376 ha	77.7 % 1586 ha	5.2% 36 ha	-4.8 % -136 ha	-4.4% -17 ha
Province	Alberta	-12.5 % -3454 ha	-69.2 % -9368 ha	41.6 % 5914 ha	13.9 % 1472 ha	57.2 % 1959 ha	4.5 % 27 ha	-3.0 % -42 ha	33.4% 116 ha
	Saskatchewan	-5.3 % -1172 ha	-53.9 % -4105 ha	20.2 % 2932 ha	23.2 % 780 ha	67.7 % 527 ha	3.3 % 16 ha	-1.7 % -24 ha	-16.6% -36 ha
	Manitoba	-7.3 % -307 ha	-85.5 % -1821 ha	73.5 % 1514 ha	18.8 % 115 ha	176.7% 223 ha	13.4% 9 ha	-9.5 % -10 ha	-20.3% -6 ha

Table 10. Upland habitat change on habitat monitoring transects in the PHJV.

Upland activity trends for surveyed transects showed increases in land with no perceived activity of 13.4 % (636.2 ha) and grazing increased 12.0 % (1562.7 ha). Land with no perceived activity may have been grazed at sometime subsequent to the survey, but no evidence of activity (past or current) was detectable at the time of the 1999 survey.

Overall, upland changes on habitat monitoring transects resulted in some significant upland composition changes (Figure 21). Cultivated lands (summerfallow and annual crops combined) decreased from 69 % of the uplands in 1985 to 62 % in 1999. Summerfallow decreased dramatically from 30 % of the upland base in 1985 to 10 % in 1999. Annually cropped land in 1985 comprised 39 % of all upland area and in 1999 this value grew to 52 %, undoubtedly most of which was formerly summerfallow. Forage crops and tame grass pastures increased from 6 % to 9 % of the surveyed land base. Unimproved grass, which includes native grass, increased from 19 % in 1985 to 22 % of the surveyed land base in 1999.



Note: Annual Crops + Summerfallow = Cultivated Lands

Figure 22. Upland habitat comparison, 1985 and 1999 on PHJV habitat monitoring transects (n=56).

Agricultural Census

The trend of decreasing cultivated acres within PHJV target areas was also reflected in the analysis of agricultural census data for 1986 and 1996. PHJV target areas decreased in cultivated area 2 % (214,898 ha), with a 28 % (610,133 ha) decrease in summer fallow, and an increase in field crops of 5 % (395,235 ha). Lands located outside target areas within the PHJV delivery area showed a decrease in cultivated acres of 1 % (211,718 ha), decrease in summerfallow of 22 % (1,253,107 ha), and an increase in crops of 6 % (1,041,389 ha).

Agricultural census data showed an increase of 36 % (206,385 ha) for tame hay in target areas and 34 % (605,223 ha) in non-target areas (note: this category is considered a component of total field crops area). Tame hay in targeted areas in 1986 accounted for 8 % of the total area in field crop, in 1996 tame hay accounted for 10 %. Non-target areas saw a change in composition of tame hay as component of total field crop area equaling an increase of 3 %. Tame or seeded pastures increased in area by 47 % (310,097 ha) for targeted areas and 35 % (566,185 ha) for non-target areas.

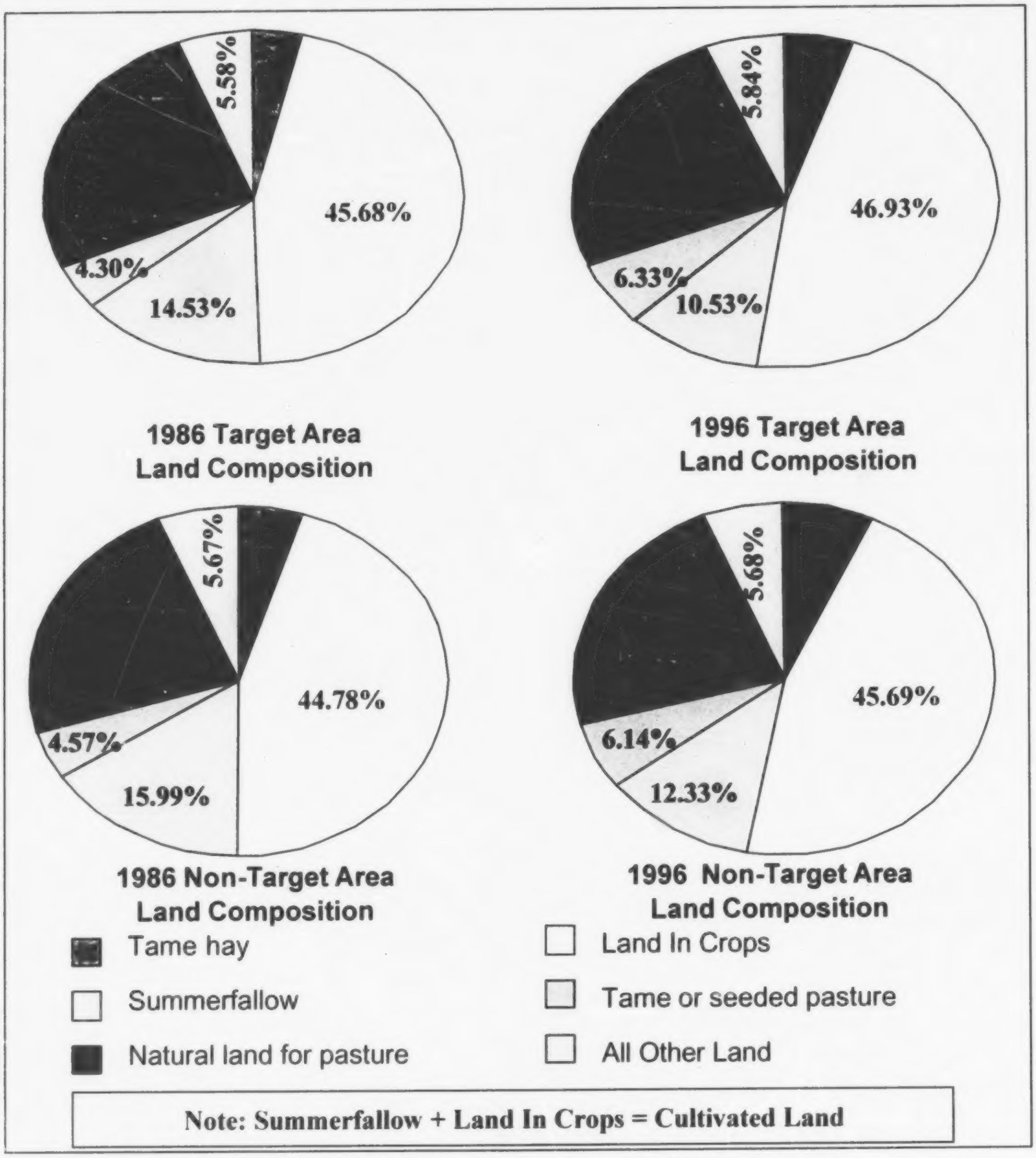
AG census data showed an decrease in natural land for pasture of 4% (141,040 ha) for targeted areas and 1% (122,346 ha) for non-target areas.

While AG census data provided comprehensive information for very large areas, it provided limited information to compare to the fine scale measurements of the more limited and detailed cover types recorded through the PHJV transect process. In regards to treed habitats, the AG census did provide an indication on the sale of forest products which gives an indication of a possible source of habitat change. The number of farms reporting sales of forest products for targeted areas increased 133 %, and increased by 169 % in non-targeted landscapes. Examples of forest products are firewood, pulpwood, logs, fence posts, pilings, standing timber, etc.

AG census data also showed large increases in cattle production which is also an indication of increased grazing pressure on target and non-target landscapes. Targeted landscapes saw an increase of 51 % in the number of cattle reported by operators while non-targeted landscapes showed an increase of 39% in cattle numbers.

Overall, land composition change reported from AG census data for targeted landscapes (Figure 22) revealed similar trends to the results reported by the habitat monitoring transects. In 1985, targeted areas were comprised of 60.20 % cultivated (summerfallow and annual crops combined) land and in 1995 cultivated area decreased to 57.46 %. Summerfallow decreased from 14.53 % in 1985 to 10.53 % in 1995, whereas annual crops increased from 45.68 % of the NAWMP targeted land base in 1985 to 46.93 % in 1995. Tame or seeded pasture lands increased from 4.30 % in 1985 to 6.33 % in1999, while natural land for pasture decreased from 26.13 % to 25.21 % of the total target area land base. Tame hay increased from 3.79 % of the targeted land base to 5.15 % from 1985 to 1995.

Land composition trends were generally similar between targeted and non-targeted landscapes (Figure 22). Tame or seeded pasture increased 2.03 % in targeted areas and increased 1.57 % in non-targeted lands. The total area of natural land for pasture declined 0.52 % for non-targeted landscapes and 0.92 % in targeted landscapes. For complete information regarding relative change trends reported by Agricultural Census data please refer to Appendix III.


1986 Target Area Land Composition

1996 Target Area Land Composition

1986 Non-Target Area Land Composition

1996 Non-Target Area Land Composition

Note: Summerfallow + Land In Crops = Cultivated Land

Figure 23. A comparison of targeted and non-targeted landscapes using Agricultural Census data from 1986 and 1996.

Upland Habitat Change Summary

Upland cover data collected through transects and agricultural census data reveal some common trends on targeted landscapes. Significant amounts of presumably productive agricultural lands have been taken out of cultivation. The most notable change on the landscape is the large decrease in summerfallow area. The reduction in summerfallow can be attributed to several factors including changing economic conditions, technological advancements, and conservation programs from various organizations (Agriculture, 2000). Decreases in summerfallow area has resulted in an increase in land area in annual crop, but overall annually cultivated area has been reduced. Tame hay (a component of annually cropped land in the AG census) and tame pasture have increased in area, a trend which is considered positive if the gains have replaced annually cultivated land. The magnitude of land change to tame pasture in NAWMP targeted landscapes is greater then that of the surrounding non-targeted landscapes within the PHJV. Tame Hay has become more prevalent in both targeted and non-targeted landscapes, however, in 1996 the proportion of area in tame hay is greater in non-targeted landscapes.

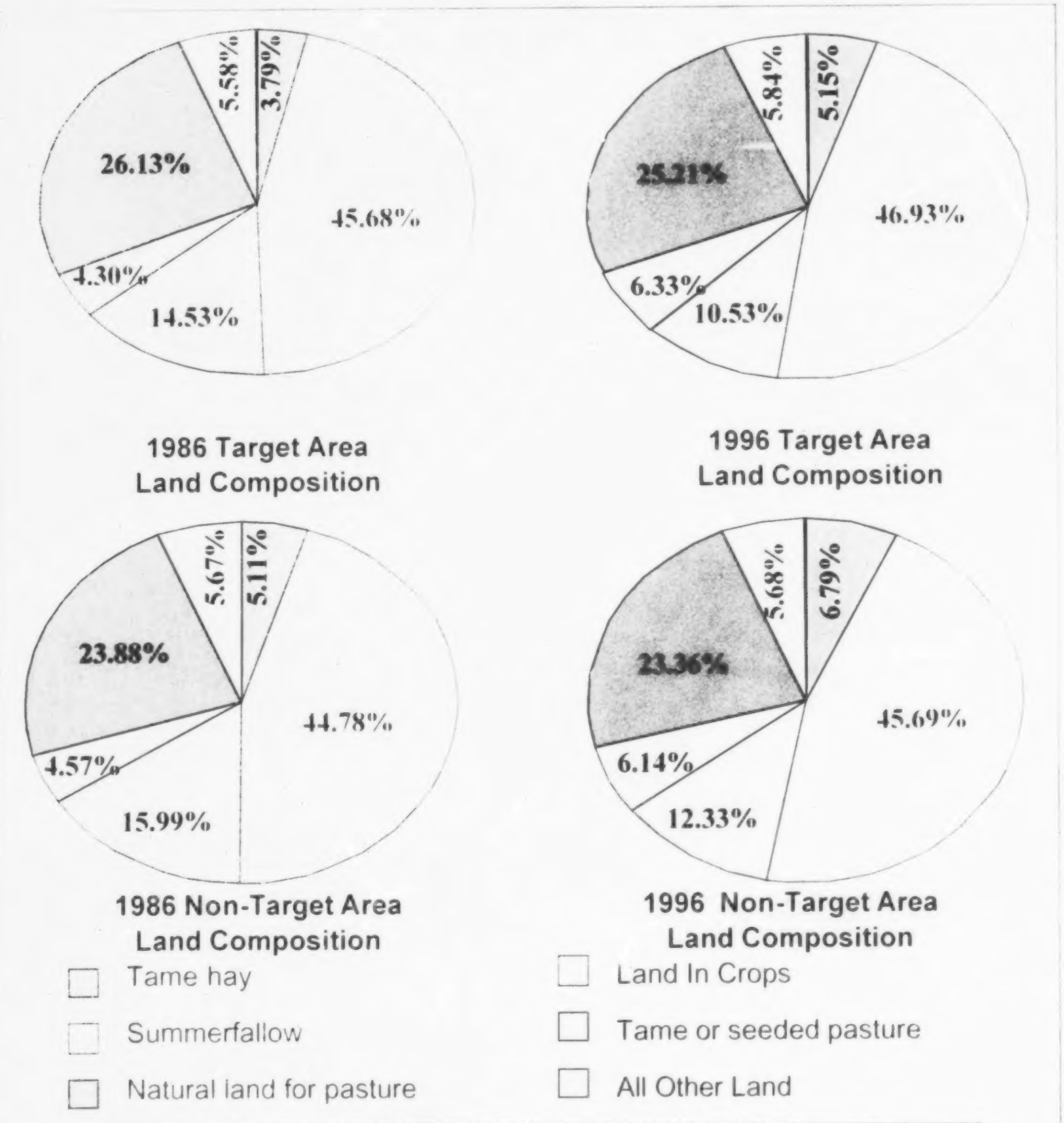
Upland Habitat Summary Trends
Total Land Area Composition Change

Cover Type	AG Census Data 1986 - 1996 Target Area 1986 to 1996	Non-Target Area 1986 to 1996	Monitoring Transect Data 1985 - 1999 (Target Areas Only)
Cultivated Land (Summerfallow + Annual Crop)	60 % to 58 %	61 % to 60 %	69 % to 62 %
Summerfallow	14 % to 10 %	16 % to 14 %	30 % to 10 %
Annual Crop	46 % to 48 %	45 % to 56 %	39 % to 52 %
Natural Land For Pasture	26 % to 25 %	23 % to 23 %	15 % to 17 %[1]
Tame Pasture/Hay and Forage Crop	8 % to 11 %	10 % to 11 %	6 % to 9 %
All Other Land	6 % to 6 %	6 % to 6 %	NA

[1] *Unimproved grass in transect method is not directly comparable to Natural Land for Pasture.*

Table 11. Total land composition change summary for Targeted and Non-targeted landscapes.

Land composition trends were generally similar between targeted and non-targeted landscapes (Figure 22). Tame or seeded pasture increased 2.03 % in targeted areas and increased 1.57 % in non-targeted lands. The total area of natural land for pasture declined 0.52 % for non-targeted landscapes and 0.92 % in targeted landscapes. For complete information regarding relative change trends reported by Agricultural Census data please refer to Appendix III.



Note: Summerfallow + Land in Crops = Cultivated Land

Figure 23. A comparison of targeted and non-targeted landscapes using Agricultural Census data from 1986 and 1996.

Upland Habitat Change Summary

Upland cover data collected through transects and agricultural census data reveal some common trends on targeted landscapes. Significant amounts of presumably productive agricultural lands have been taken out of cultivation. The most notable change on the landscape is the large decrease in summerfallow area. The reduction in summerfallow can be attributed to several factors including changing economic conditions, technological advancements, and conservation programs from various organizations (Agriculture, 2000). Decreases in summerfallow area has resulted in an increase in land area in annual crop, but overall annually cultivated area has been reduced. Tame hay (a component of annually cropped land in the AG census) and tame pasture have increased in area, a trend which is considered positive if the gains have replaced annually cultivated land. The magnitude of land change to tame pasture in NAWMP targeted landscapes is greater then that of the surrounding non-targeted landscapes within the PHJV. Tame Hay has become more prevalent in both targeted and non-targeted landscapes, however, in 1996 the proportion of area in tame hay is greater in non-targeted landscapes.

Upland Habitat Summary Trends
Total Land Area Composition Change

	AG Census Data 1986 - 1996		
Cover Type	**Target Area 1986 to 1996**	**Non-Target Area 1986 to 1996**	**Monitoring Transect Data 1985 - 1999 (Target Areas Only)**
Cultivated Land (Summerfallow + Annual Crop)	60 % to 58 %	61 % to 60 %	69 % to 62 %
Summerfallow	14 % to 10 %	16 % to 14 %	30 % to 10 %
Annual Crop	46 % to 48 %	45 % to 56 %	39 % to 52 %
Natural Land For Pasture	26 % to 25 %	23 % to 23 %	15 % to 17 %[1]
Tame Pasture/Hay and Forage Crop	8 % to 11 %	10 % to 11 %	6 % to 9 %
All Other Land	6 % to 6 %	6 % to 6 %	NA

[1] *Unimproved grass in transect method is not directly comparable to Natural Land for Pasture.*

Table 11. Total land composition change summary for Targeted and Non-targeted landscapes.

There are some discrepancies between AG census data and the transect data regarding the trend in unimproved grassland or natural land for pasture. The transect data suggests that total land covered by unimproved grass has increased by 2 % where the AG census data suggests the overall area has decreased by 1 % (Table 10). This discrepancy is the result of the unimproved grassland cover type not being exclusive to pasture in the transect methodology. Unimproved grassland included natural land for pasture, idle lands around buildings, farm yards, ditches, waste lands, etc. The AG census data included non-pastured unimproved land in the all other land category. From 1986 to 1996 the AG census data reports an increase of 3 % (22,847 ha) for the all other land area within targeted landscapes. The all other land category in the AG census data structure does contain various land cover types which can be considered as wildlife habitat. The definition of unimproved pasture defined by the transect methodology was not species based. Therefore pastures that were tame in 1985 were reclassified as unimproved in 1999 if the pasture had been unseeded for greater than five years ("gone wild"). It is likely that the reporting operator may still consider the wild tame pasture land as tame pasture and report it as so in the Agricultural Census. It was noted on a few transects that a significant amount of previously tame grass or cultivated land was reclassified as unimproved grass in 1999. The increase in unimproved pasture area reported by the PHJV transects was also the result of cropland or wild tame pasture being converted to grazing land which was classified as unimproved land in 1999. The transect methodology picks up on fine scale changes in habitat area whereas the AG census data can be considered very coarse and is unlikely to report any habitat fragment data. This fine scale measurement is better suited for picking up categories such as unimproved grass in smaller fragments within larger units whereas the AG census methodology would lump such fragments into the dominant land cover for the selected area.

Another disagreement between the AG census results and the monitoring transect results is the magnitude of change for summerfallow and annual crops. In the case of summerfallow the AG census reports a change in target area land composition of - 4 % and the monitoring transects data shows a – 20 % change in total land area under summerfallow. As the baseline dataset was constructed from early May imagery it is likely that summerfallow was over reported due to the difficulty of separating out what would be seeded or not that year. It is probable that much of the land reported as summerfallow was seeded that year and thus the low baseline percentage for annual crop (Table 10) in the 1985 transect data. There is also a 4 year difference between the AG census data survey date (1995 farm year recorded in the 1996 census of agriculture) and the 1999 survey date for the monitoring transect. This temporal difference may also cause some disagreement between the two methods. The more recent transect data suggests that the trends in regards to summerfallow and annual cropland (cultivated land) have continued.

The all other land category of the AG census does provide a measure of idled lands which are included in this category. All other land lumps various non-production lands of which a portion can be considered as habitat lands. Targeted areas showed a 5 % (40,427 ha) increase in the all other land category whereas non-targeted lands showed a 1 % (20,102 ha) decline. This increase is similar to the increasing trend reported by the transect category unimproved grass, but the 16.2 % increase in area is much greater then that reported by the AG census. Overall, these categories demonstrate an increase in what can be considered non-agricultural production lands. However, the increase is very small when compared to the entire land base of the targeted areas and resulted in an overall land composition change from 5.58 % of the target area total land base in 1986 to 5.84 % in 1996 (Figure 22).

The Agricultural Census data measures various practices that are considered important PHJV conservation tools. An example of a measured conservation practice is winter wheat and fall rye (for complete change information regarding AG census variables, please refer to Appendix III). Winter wheat and fall rye data were extracted from the AG census for targeted and non-targeted lands within the PHJV (Table 12).

Variable	**Non-Target Area**		**Target Area**	
	Change	**% Change**	**Change**	**% Change**
Winter Wheat Farms Reporting	-5241	-86%	-1525	-78%
Fall Rye Farms Reporting	-2306	-49%	-538	-37%

Table 12. AG Census 1986 to 1996 change in farms reporting and hectares reported for winter wheat and fall rye.

The reduced tillage and pesticide requirements, retention of stubble residue on the soil surface to reduce erosion, and the reduced disturbance to wildlife make winter wheat one of the most conservation friendly crop production tools available in the Canadian prairies (Fowler 1992). It should be noted that the data shown in the table above relates two points in time, and does not provide an indication of annual variation in seeded areas. Winter wheat and fall rye plantings can be expected to fluctuate annually and therefore one can not rely specifically on 5 year data to properly interpret the trends for these conservation type crops. Winter wheat had an abnormally strong uptake in the early 1980s but, problems such as improper planting and management techniques, climatic conditions, stem rust epidemics, and falling world wheat prices resulted in dramatic declines in the area of winter wheat seeded through the mid 80's to mid 90's (Fowler 1992). Fowler (1992) indicated that the priority placed on winter wheat by conservation groups could have a significant impact on the direction of the winter wheat curve. Fowler also indicated that farm survival will override conservation priorities under adverse economic conditions, this appears to have been the case with winter wheat and fall rye. The magnitude of decrease outside targeted landscapes was higher then inside target areas. This suggests that the conservation efforts promoting fall seeded crops within

transect category unimproved grass, but the 16.2 % increase in area is much greater then that reported by the AG census. Overall, these categories demonstrate an increase in what can be considered non-agricultural production lands. However, the increase is very small when compared to the entire land base of the targeted areas and resulted in an overall land composition change from 5.58 % of the target area total land base in 1986 to 5.84 % in 1996 (Figure 22).

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Variable	**Non-Target Area**		**Target Area**	
	Change	**% Change**	**Change**	**% Change**
Winter Wheat Farms Reporting	-5241	-86%	-1525	-78%
Winter Wheat Hectares	-326578	-84%	-98946	-79%
Fall Rye Farms Reporting	-2306	-49%	-538	-37%
Fall Rye Hectares	-82586	-45%	-20478	-37%

Table 12. AG Census 1986 to 1996 change in farms reporting and hectares reported for winter wheat and fall rye.

The reduced tillage and pesticide requirements, retention of stubble residue on the soil surface to reduce erosion, and the reduced disturbance to wildlife make winter wheat one of the most conservation friendly crop production tools available in the Canadian prairies (Fowler 1992). It should be noted that the data shown in the table above relates two points in time, and does not provide an indication of annual variation in seeded areas. Winter wheat and fall rye plantings can be expected to fluctuate annually and therefore one can not rely specifically on 5 year data to properly interpret the trends for these conservation type crops. Winter wheat had an abnormally strong uptake in the early 1980s but, problems such as improper planting and management techniques, climatic conditions, stem rust epidemics, and falling world wheat prices resulted in dramatic declines in the area of winter wheat seeded through the mid 80's to mid 90's (Fowler 1992). Fowler (1992) indicated that the priority placed on winter wheat by conservation groups could have a significant impact on the direction of the winter wheat curve. Fowler also indicated that farm survival will override conservation priorities under adverse economic conditions, this appears to have been the case with winter wheat and fall rye. The magnitude of decrease outside targeted landscapes was higher then inside target areas. This suggests that the conservation efforts promoting fall seeded crops within targeted landscapes by the PHJV may be resulting in a dampening of the negative long-term trend in winter wheat and fall rye plantings.

MANAGEMENT RECOMMENDATIONS.

1. In order to provide a better indication of possible PHJV influences on wetland conservation within targeted landscapes, it is recommended that existing habitat monitoring transect data outside target areas be resurveyed for trend analysis purposes. Results from this study could be used to compare targeted and non-targeted habitat trends. The additional transects will also provide substantial information on important pintail areas, additional grassland ecoregion sites and provide more comprehensive information across the entirety of the PHJV region.

2. Comparing habitat monitoring projects results among projects is not adequate for habitat monitoring purposes. The PHJV needs a reliable habitat monitoring program that is ongoing, adaptive, and capable of reporting detailed habitat trend information across the PHJV region.

3. The current needs of the PHJV partners regarding wetland trends are not more easily met using remote sensing techniques over air photo interpretation. Wetland monitoring requires human interpretation of high resolution imagery backed up with extensive ground checking methods. Of great importance is the reliability of baseline data to compare against. This data exists in the habitat monitoring transects originally surveyed by Millar. It is recommended that this complete dataset be updated and assembled digitally using modern tools and techniques.

4. Total, landscape wide wetland inventories are not required to conduct wetlands habitat monitoring. It is recommended that the existing sampling network be utilized as a means to providing estimates of wetland trends within the PHJV boundary. Landscape inventories should not be disregarded entirely as they provide useful planning tools, and would likely complement the current habitat sampling network.

5. Agricultural Census data provided by Statistics Canada is an economical and comprehensive data source for uplands habitat change detection within targeted and non-targeted landscapes. Continued efforts are required in this area to build better methods and thus improved detection of PHJV influences on uplands habitat change. Better links to Provincial and Federal annual agricultural data sources should be developed for monitoring purposes. This data can be used as a validation of some of the major upland cover types monitored through the transects.

6. The results of this study suggest that small, shallow wetlands are heavily impacted and as a result many of these wetlands are under considerable threat to basin destruction. This may be especially true during drought conditions such as those currently occurring for large portions of the PHJV. Conservation efforts

such as public education on the value of these wetlands (wet or dry) to wildlife and the environment must continue.

7. Annual data provided by Canadian Wildlife Service air ground surveys should be utilized as an indicator of annual variation in wetlands habitat within the PHJV. This dataset should be the primary tool for linking annual variations in habitats with annual population variation and translating wetland area loss and impacts into waterfowl loss and impacts. The long-term program would be complimentary to the annual program.

8. The establishment of broad landscape goals defined for targeted landscapes combined with the habitat monitoring program could be used to assist in evaluating the success of the PHJV. Goals should be structured towards land composition shifts that are desired.

9. Currently no transect baseline data exists for the Grand Prairie/ Peace River area of the PHJV. It is recommended that baseline data be collected for this area. Baseline data collection should conform to methods established by the current program.

Appendix I
Study Area Maps

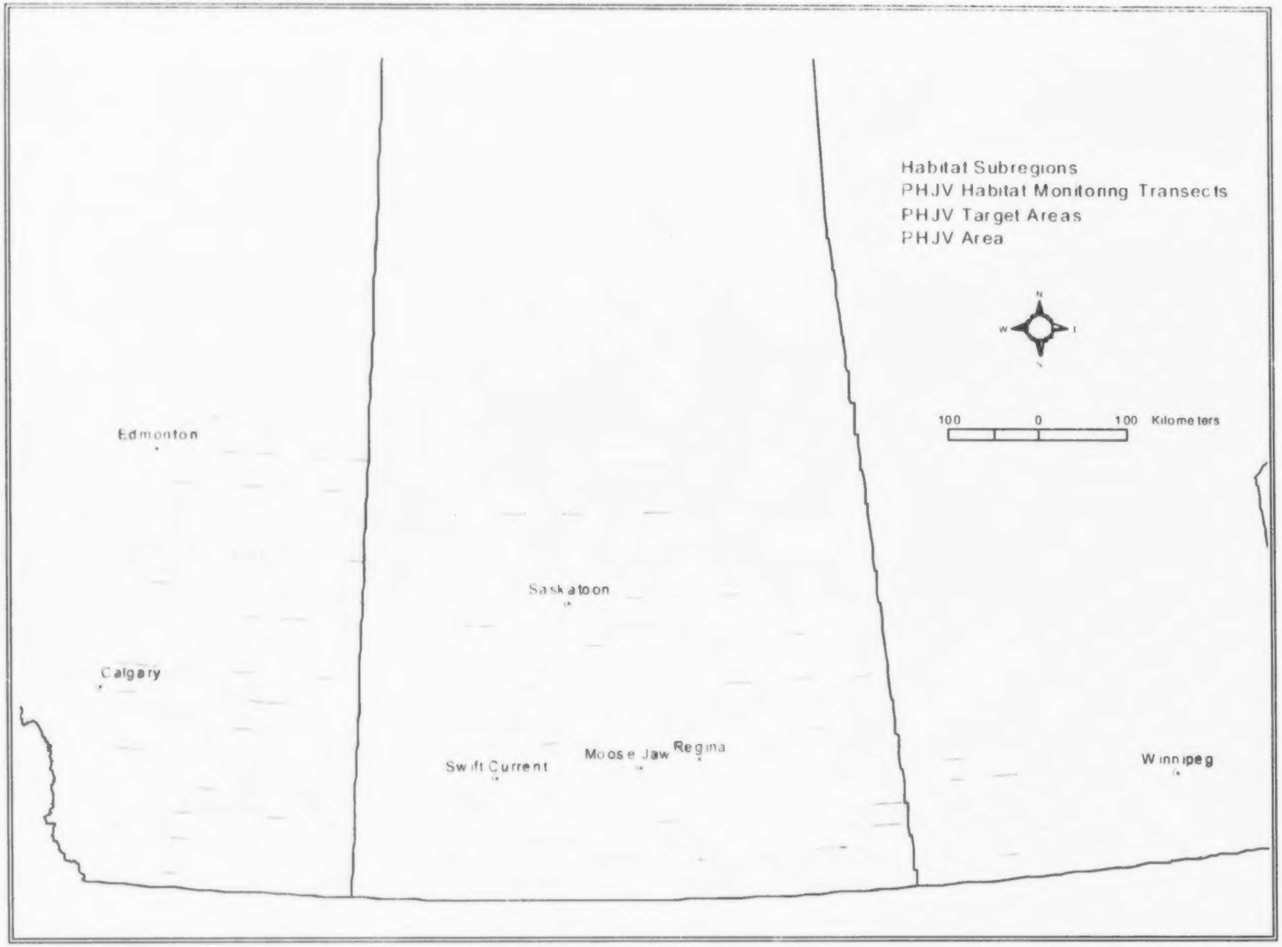

Habitat Subregions
PHJV Habitat Monitoring Transects
PHJV Target Areas
PHJV Area
N
W
E
S
100
0
100
Kilometers
Edmonton
Calgary
Saskatoon
Swift Current
Moose Jaw
Regina
Winnipeg

Figure 24. PHJV study area stratified by Habitat Subregions (Adams 1988).

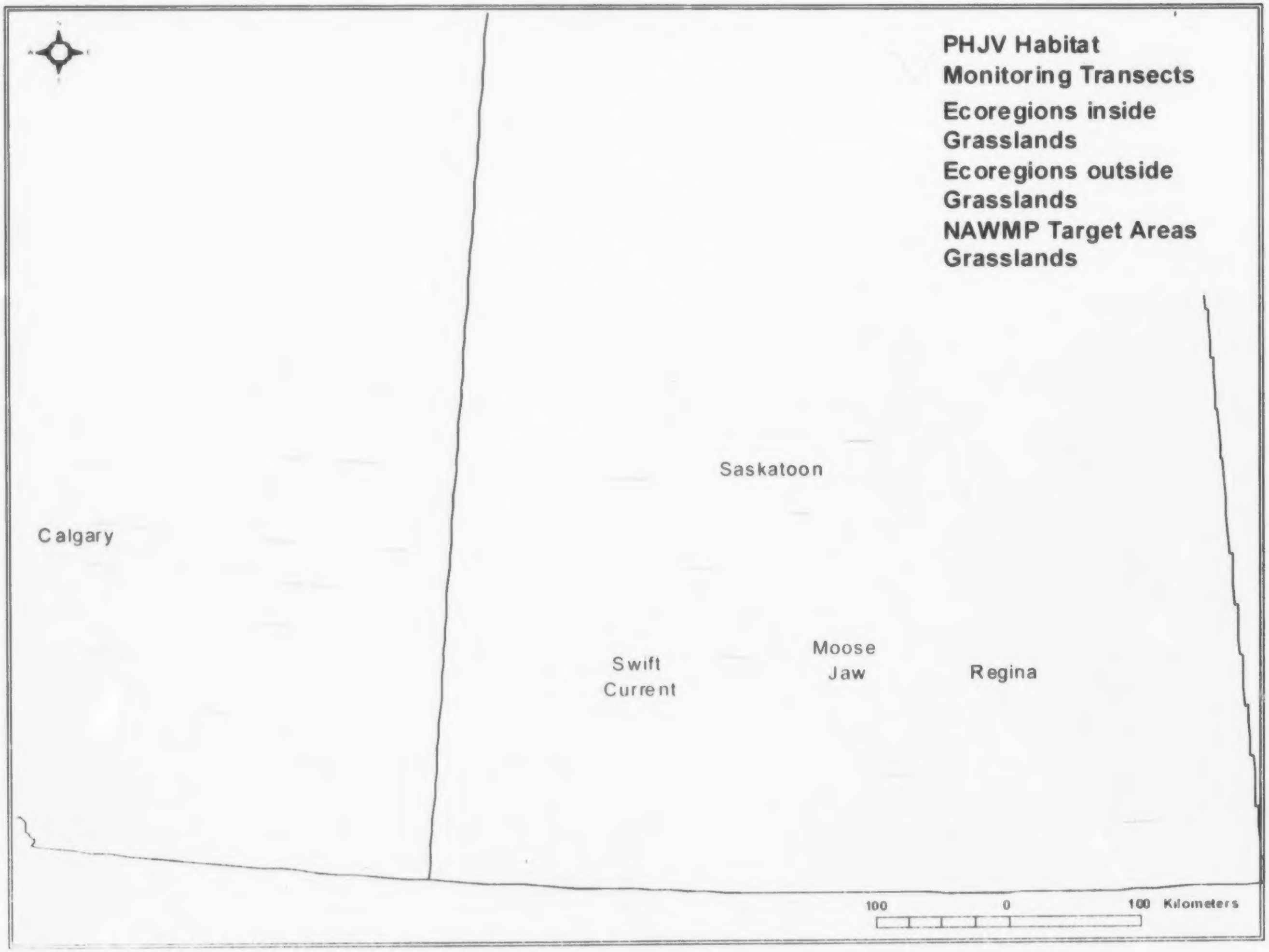

PHJV Habitat
Monitoring Transects
Ecoregions inside
Grasslands
Ecoregions outside
Grasslands
NAWMP Target Areas
Grasslands
Calgary
Saskatoon
Swift Current
Moose Jaw
Regina
100
0
100 Kilometers

Figure 25. Grasslands landscape of the PHJV study area.

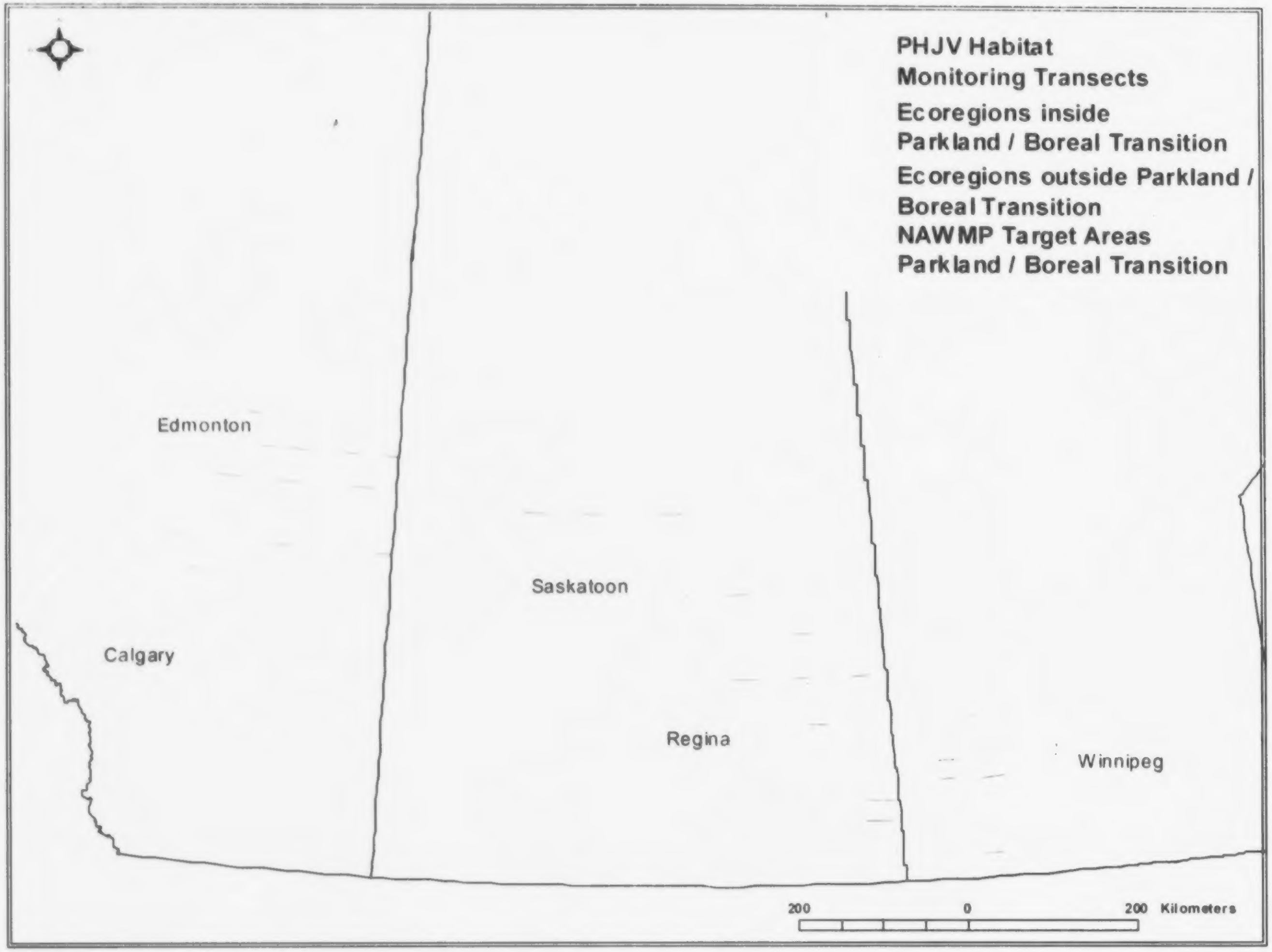

PHJV Habitat
Monitoring Transects
Ecoregions inside
Parkland / Boreal Transition
Ecoregions outside Parkland /
Boreal Transition
NAWMP Target Areas
Parkland / Boreal Transition
Edmonton
Calgary
Saskatoon
Regina
Winnipeg
200
0
200 Kilometers

Figure 26. Parkland/Boreal Transition landscape of the PHJV study area.

Appendix II
Classification Scheme and Field Forms

UPLANDS

Woodlands

Code	Vegetation Cover	Description
W1	TALL TREES	stands of tall trees (> 5 m)
W2	REGULAR SPACED SMALL TREES WITH TALL/MID SHRUBS	stands of regularly spaced small trees (< 5 m) mixed with tall/mid shrubs (0.5 to 1.5+ m)includes shelterbelts and hedge rows
W3	IRREGULAR SPACED SMALL TREES WITH TALL/MID SHRUBS	stands of irregularly spaced small trees (< 5 m) mixed with tall/mid shrubs (0.5 to 1.5+ m)
W4	LOW SHRUB	stands of low shrub (< 5 m) includes areas with predominant buckbrush, wildrose, sagebrush

Non-woody

Code	Vegetation Cover	Description
V1	ANNUAL CROP	annually cultivated crop including wheat, oats, barley, mixed grains, corn (for grain, for silage), rye (fall, spring), canola (rapeseed), flaxseed, and other crops
V2	IMPROVED GRASS	1. alfalfa and other alfalfa mixtures cut for hay or silage 2. all other tame hay cut for hay or silage (including clovers) 3. other fodder crops cut for hay or silage 4. improved pastures that have been seeded down for less than 5 years and are part of ordinary crop rotation
V3	UNIMPROVED GRASS	1. unimproved land for grazing, "wild pastures", and pastures seeded for more than 5 years 2. pastures containing sedges and forbs 3. native grasses

WETLANDS

Code	Cover type	Description
Z1	STREAMS AND RIVERS	streams and rivers
Z3	LAKES AND PONDS	permanent open water lakes and ponds that contains some submerged plants this includes any open water marshes characterized by intermittent growth of emergents such as reeds, rushes and tall grass alternating with open water conditions
Z4	SALINE LAKES AND PONDS	permanent open water alkali wetlands, open water of high salinity
Z6	TRANSITIONAL OPEN WATER	permanent open water lakes and ponds that lacks submerged , shallow, open water plants
V4	EMERGENT DEEP MARSH	semi permanent shallow water with tall emergents such as reeds, and rushes
Z2	IRRIGATION CANALS	irrigation canals
Z5	ARTIFICIAL WATER	reservoirs and dugouts
V3	GRASS AND SEDGE	shallow marsh to low prairie type wetlands, dominated by grass and sedge cover

DISTURBED

Code	**Cover type**	**Description**
V5	*DISTURBED GRASS*	*non-woody plants representing complexes of disturbed species*
X0	*BARE SURFACE*	*bare ground including summerfallow does not include a bare field that has been seeded (should classify this as V1 or V2).*
Y0	*CONSTUCTED COVER*	*building, well site, compressor stations*

UNCLASSIFIED

Code	Cover type	Description
08	UNCLASSIFIED	

Wetland identification column

Code		Description
S	WETLAND STATUS	wetland is a segment of a watercourse
1-999	WETLAND ID	wetland number (up to 3 digits) numbering starts at 1 for each quarter section

Marginal primary cover classification

Code	Description
Blank	identifies polygons which are uplands rather than wetlands
0	wetland with non-natural cover as dominant fringe type
G	wetland with unimproved grass (V3) as dominant fringe type
S	wetland with tree or shrub cover (W1,W2,W3,W4) as dominant fringe type

Marginal secondary cover classification

Code	Description
8	wetland with >75% of one fringe type
0	wetland with non-natural cover as secondary fringe type
G	wetland with unimproved grass (V3) as secondary fringe type
S	wetland with tree or shrub cover (W1,W2,W3,W4) as secondary fringe type

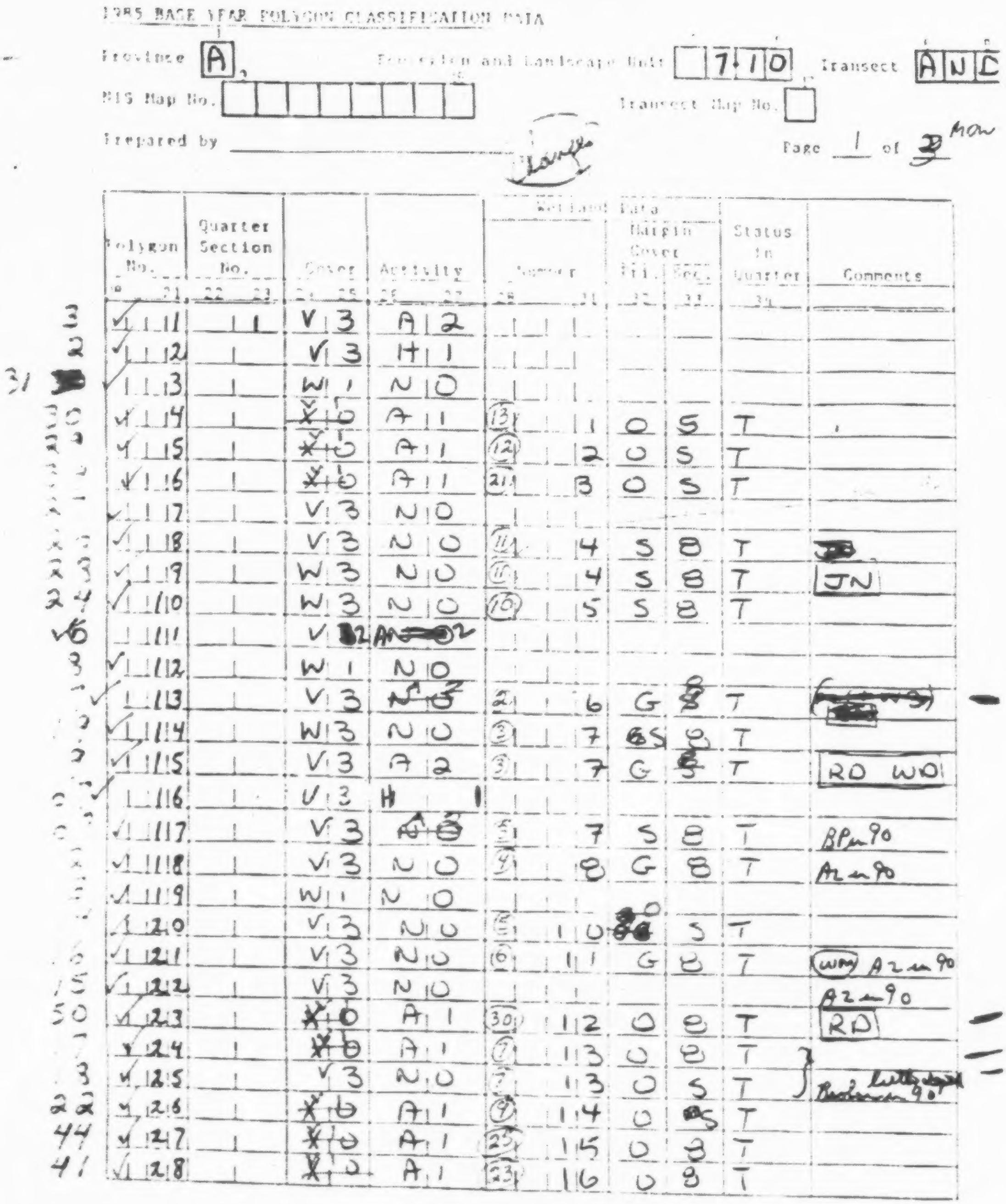
Extent to which quarter section is confined to quarter section

Code	Description
T	wetland lies totally within the quarter section
P	wetland lies only partially within quarter section

Land Activity

Code	Class name	Description
A1	CROP	growing annual tillage crop
A2	FORAGE	growing forage crop
A3	GRAZING	grazing
A4	OTHER PRODUCTIVE	other productive land (berry farm, sod farm, etc.)
A5	AG SITE	agricultural site activity including grain bins, farmyards, etc.
F0	FORESTRY	forestry activity
G0	WILDLIFE	wildlife and fisheries activity
R0	RECREATION	recreational activity
D0	DWELLING	dwelling activity
H1	ROAD	road
H2	RAIL	railway
H3	TRANSPORT	other transportation
H4	COMMUNICATION	communication activity
M0	MANUFACTURING	manufacturing and commercial activity
M1	WASTES	treating and disposal of wastes
E0	EXTRACTION	extraction activity
J0	INSTITUTIONAL	institutional activity
P1	CONSERVATION	research and conservation
B3	IDLE	idle land
N0	NONE	no perceived activity
L0	TRANSITION	land in transition
P2	FLOOD	flood control and drainage
P4	IRRIGATION	irrigation

P3	OTHER	other activity
B1	FORMER AG	former agricultural activity
B2	FORMER EXTRAC	former activity
08	UNCLASSIFIED	Unclassified



1985 BASE YEAR POLYGON CLASSIFICATION DATA

Province A

[illegible] and Landscape Unit 7 1 0

Transect A N C

MIS Map No.

Transect Map No.

Prepared by

Page 1 of 3 Mon

	Polygon No.	Quarter Section No.	Cover	Activity	Wetland Data Number	Margin Cover Pri.	Margin Cover Sec.	Status in Quarter	Comments
3	✓ 1 1	1 1	V 3	A 2					
2	✓ 1 2	1	V 3	H 1					
31	✓ 1 3	1	W 1	N 0					
	✓ 1 4	1	X 0	A 1	(13) 1	O	S	T	
	✓ 1 5	1	X 0	A 1	(12) 2	O	S	T	
	✓ 1 6	1	X 0	A 1	(21) 3	O	S	T	
	✓ 1 7	1	V 3	N 0					
	✓ 1 8	1	V 3	N 0	(11) 4	S	8	T	
3	✓ 1 9	1	W 3	N 0	(11) 4	S	8	T	JN
24	✓ 1 10	1	W 3	N 0	(10) 5	S	8	T	
✓6	1 11	1	V	A 2					
3	✓ 1 12	1	W 1	N 0					
	✓ 1 13	1	V 3	N 0	(2) 6	G	8	T	
	✓ 1 14	1	W 3	N 0	(3) 7	S	8	T	
	✓ 1 15	1	V 3	A 2	(3) 7	G	S	T	RD WO
	✓ 1 16	1	V 3	H 1					
	✓ 1 17	1	V 3	A 0	(5) 7	S	8	T	BP 90
	✓ 1 18	1	V 3	N 0	(4) 8	G	8	T	A 90
	✓ 1 19	1	W 1	N 0					
	✓ 1 20	1	V 3	N 0	(5) 10	O	S	T	
	✓ 1 21	1	V 3	N 0	(6) 11	G	8	T	(WM) A2 90
15	✓ 1 22	1	V 3	N 0					A2 90
50	✓ 1 23	1	X 0	A 1	(30) 12	O	8	T	RD
	✓ 1 24	1	X 0	A 1	(7) 13	O	8	T	
3	✓ 1 25	1	V 3	N 0	(7) 13	O	S	T	[illegible] 90
22	✓ 1 26	1	X 0	A 1	(9) 14	O	S	T	
44	✓ 1 27	1	X 0	A 1	(25) 15	O	8	T	
41	✓ 1 28	1	X 0	A 1	(23) 16	O	8	T	

Figure 27. Example of a habitat monitoring field form.

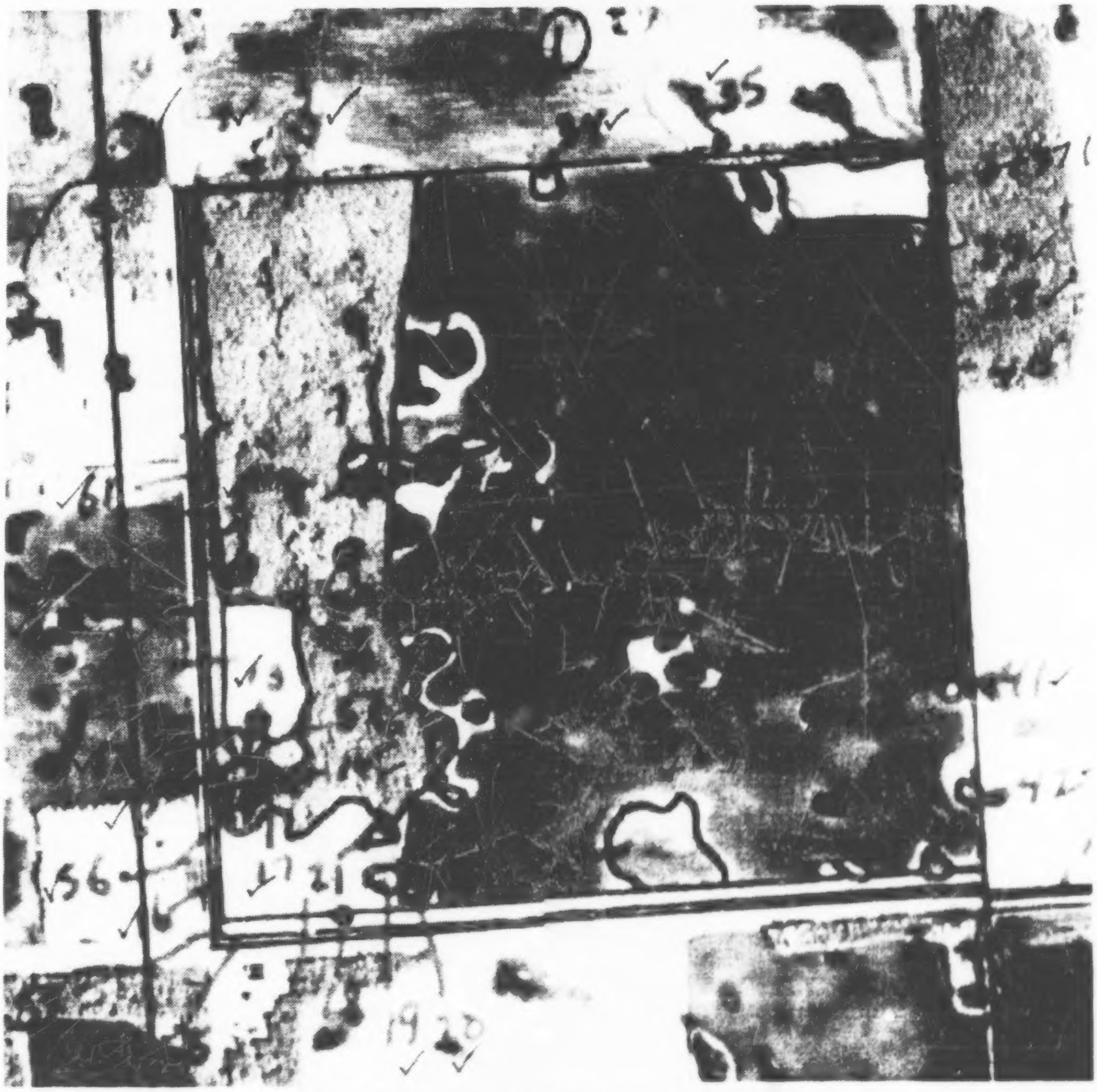
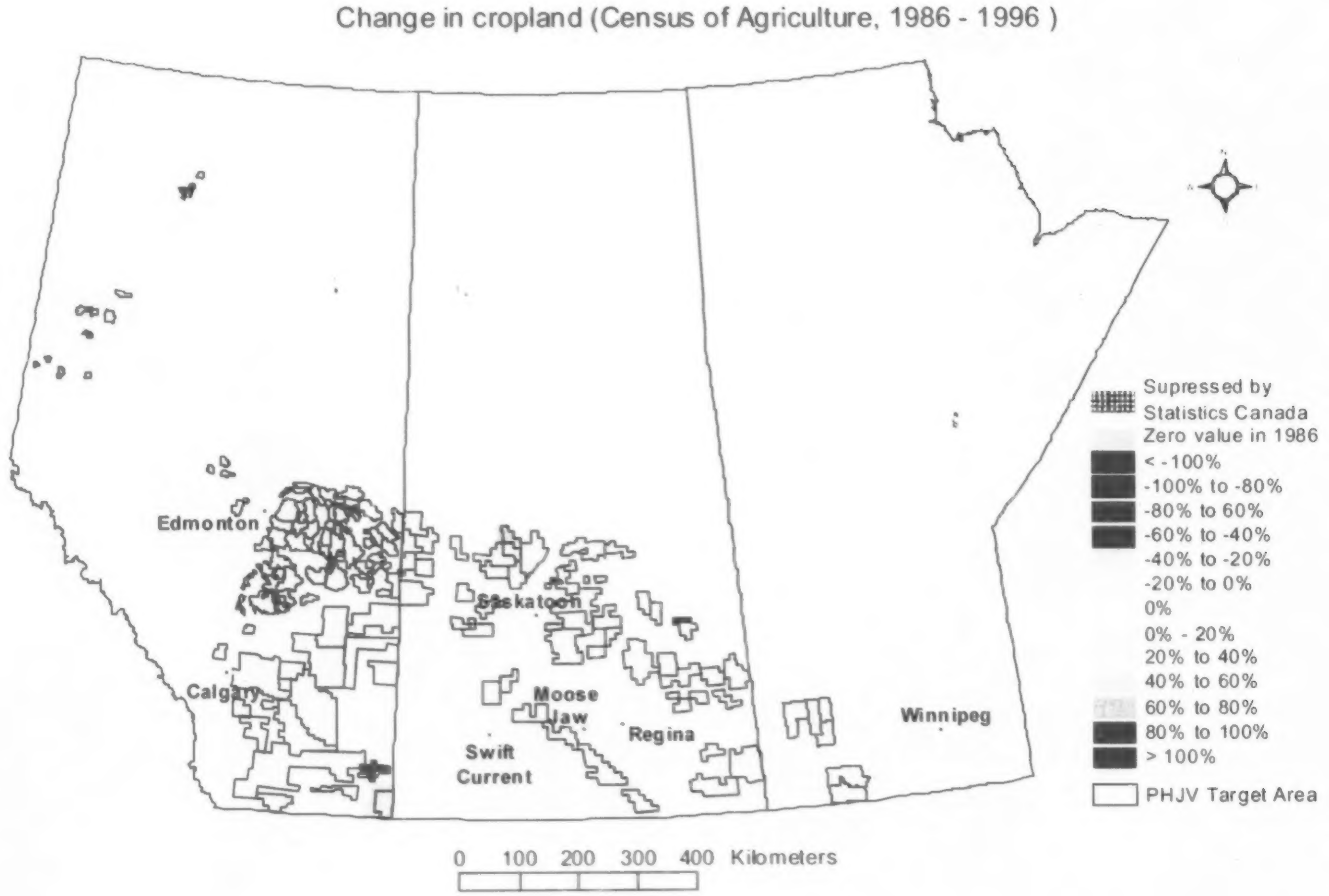

35
61
56
17
21
19
20

Figure 28. Example of a field blowup of a sampled quarter section.

Appendix III
Agricultural Census Data Maps and Tables



Change in cropland (Census of Agriculture, 1986 - 1996)
Edmonton
Calgary
Saskatoon
Moose Jaw
Swift Current
Regina
Winnipeg
▨ Supressed by Statistics Canada
Zero value in 1986
< -100%
-100% to -80%
-80% to 60%
-60% to -40%
-40% to -20%
-20% to 0%
0%
0% - 20%
20% to 40%
40% to 60%
60% to 80%
80% to 100%
> 100%
☐ PHJV Target Area
0 100 200 300 400 Kilometers

Figure 29. Percent change in cropland area for NAWMP targeted landscapes.

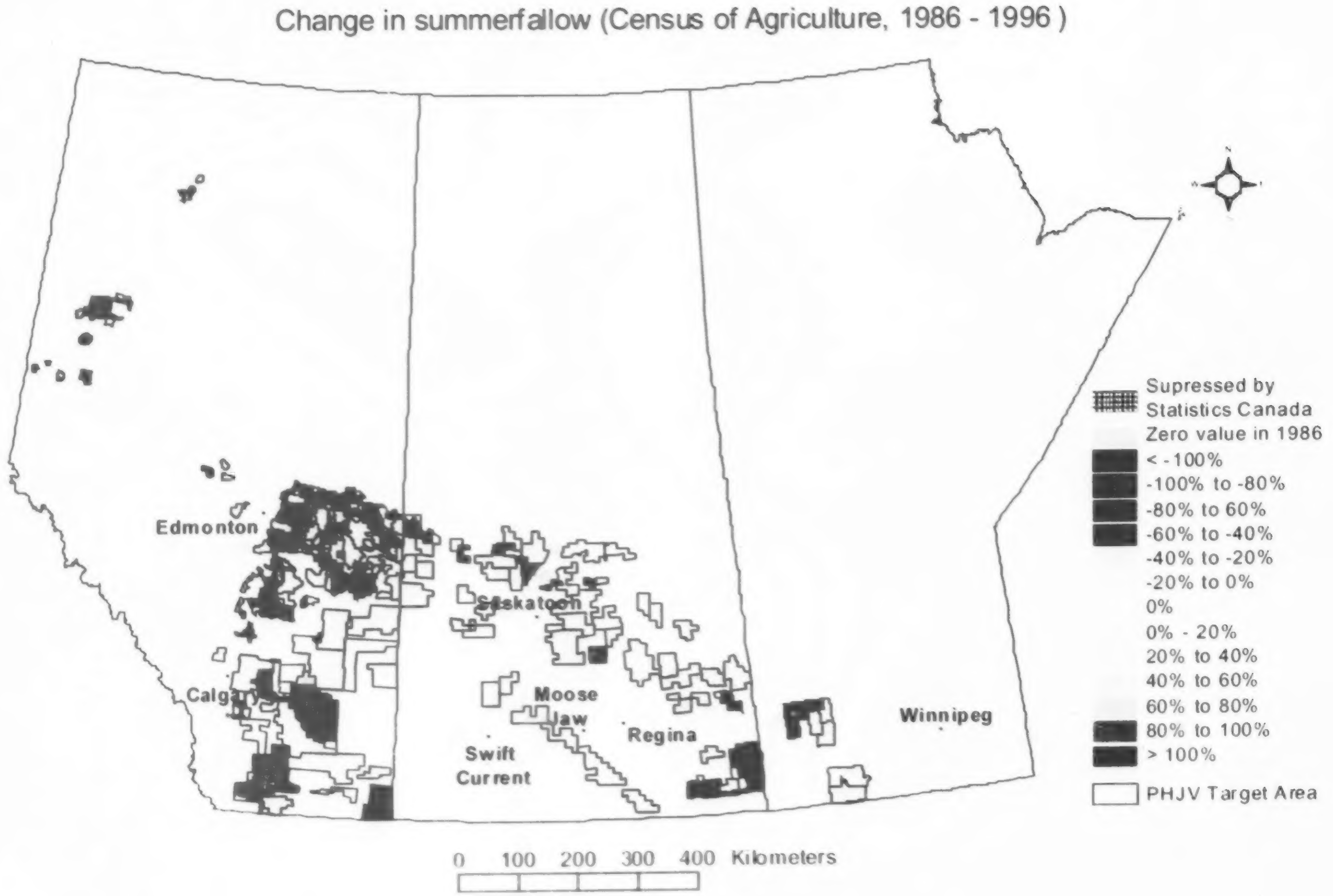

Change in summerfallow (Census of Agriculture, 1986 - 1996)
Edmonton
Calgary
Saskatoon
Moose Jaw
Regina
Swift Current
Winnipeg
0 100 200 300 400 Kilometers
Supressed by Statistics Canada
Zero value in 1986
< -100%
-100% to -80%
-80% to 60%
-60% to -40%
-40% to -20%
-20% to 0%
0%
0% - 20%
20% to 40%
40% to 60%
60% to 80%
80% to 100%
> 100%
PHJV Target Area

Figure 30. Percent change of summerfallow area for NAWMP targeted landscapes.

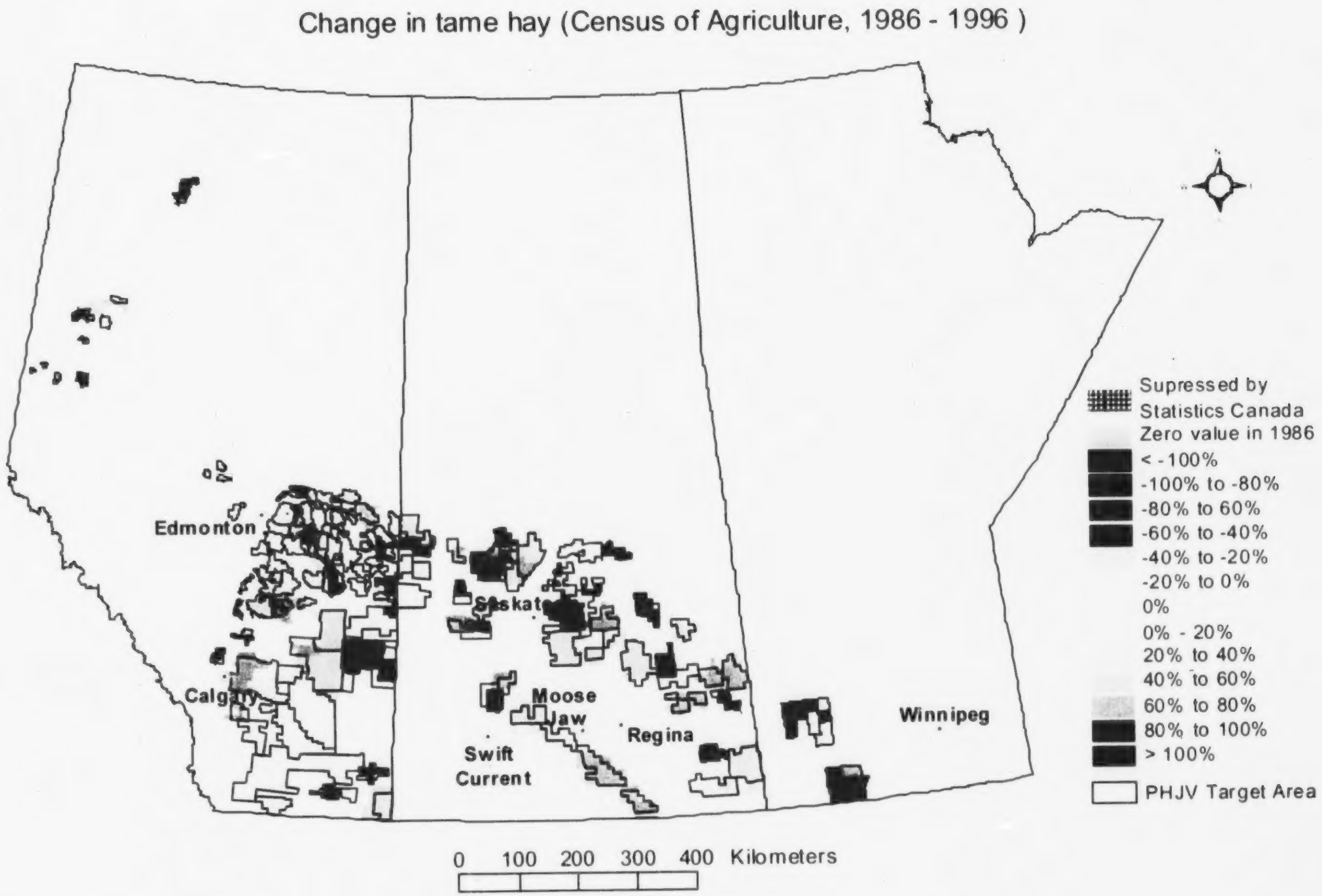

Change in tame hay (Census of Agriculture, 1986 - 1996)
Edmonton
Calgary
Saskat
Moose Jaw
Swift Current
Regina
Winnipeg
Supressed by Statistics Canada
Zero value in 1986
< -100%
-100% to -80%
-80% to 60%
-60% to -40%
-40% to -20%
-20% to 0%
0%
0% - 20%
20% to 40%
40% to 60%
60% to 80%
80% to 100%
> 100%
PHJV Target Area
0
100
200
300
400
Kilometers

Figure 31. Percent change of tame hay area for NAWMP targeted landscapes.

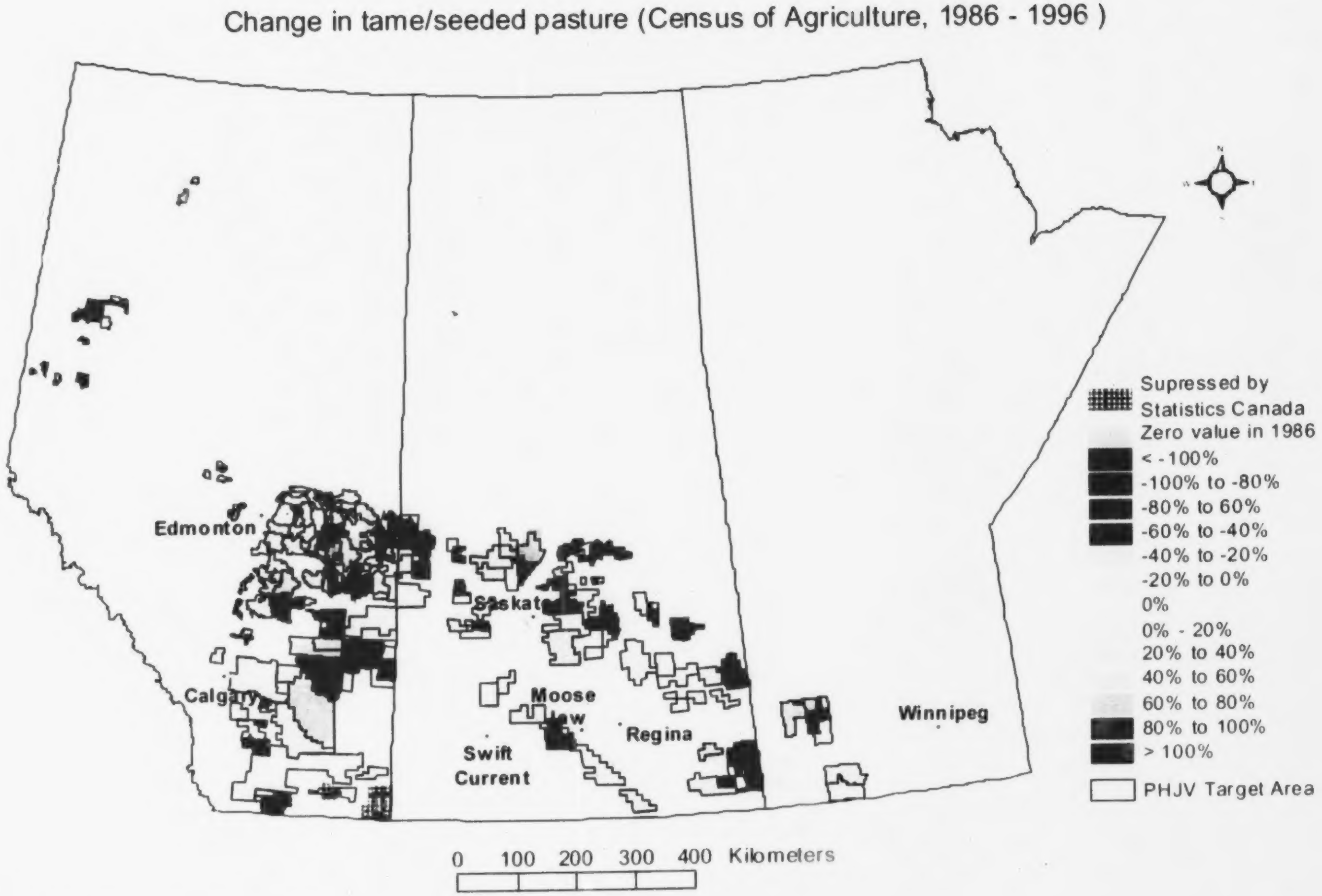

Change in tame/seeded pasture (Census of Agriculture, 1986 - 1996)
Edmonton
Calgary
Saskat
Moose Jaw
Swift Current
Regina
Winnipeg
Supressed by Statistics Canada
Zero value in 1986
< -100%
-100% to -80%
-80% to 60%
-60% to -40%
-40% to -20%
-20% to 0%
0%
0% - 20%
20% to 40%
40% to 60%
60% to 80%
80% to 100%
> 100%
PHJV Target Area
0 100 200 300 400 Kilometers

Figure 32. Percent change of tame/seeded pasture area for NAWMP targeted landscapes.

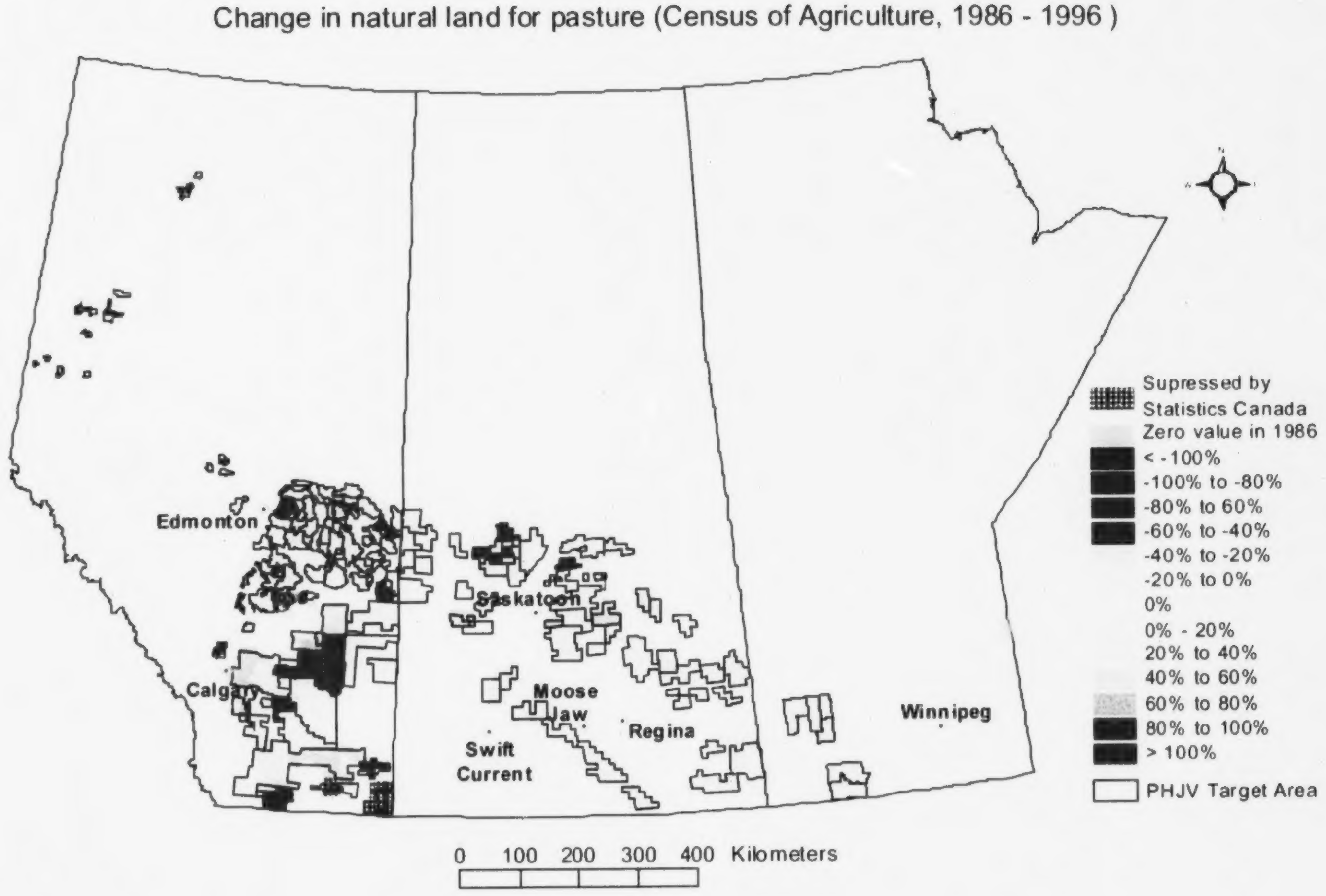

Change in natural land for pasture (Census of Agriculture, 1986 - 1996)
Edmonton
Calgary
Saskatoon
Moose Jaw
Regina
Swift Current
Winnipeg
Supressed by Statistics Canada
Zero value in 1986
< -100%
-100% to -80%
-80% to 60%
-60% to -40%
-40% to -20%
-20% to 0%
0%
0% - 20%
20% to 40%
40% to 60%
60% to 80%
80% to 100%
> 100%
PHJV Target Area
0 100 200 300 400 Kilometers

Figure 33. Percent change of natural land for pasture area for NAWMP targeted landscapes.

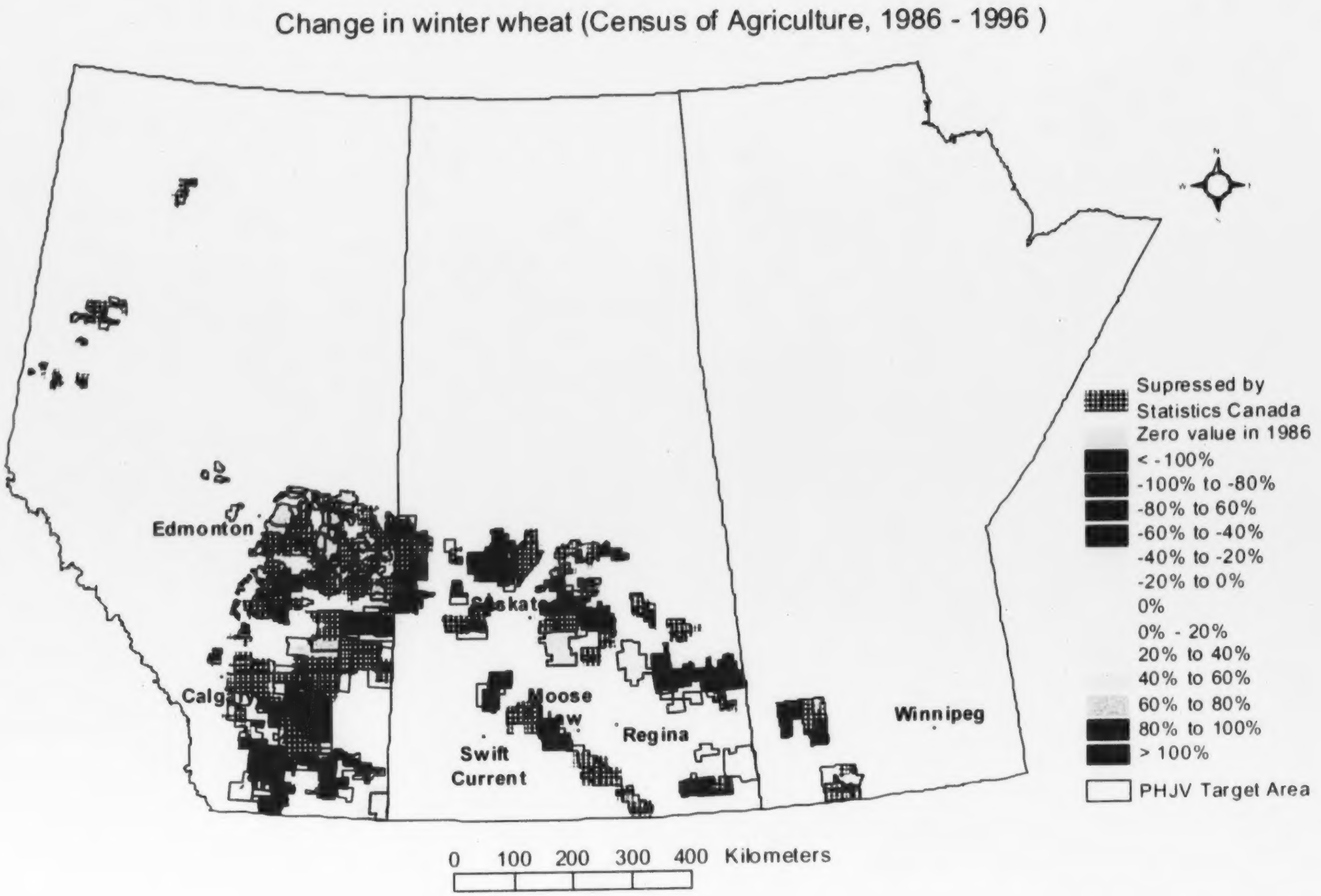

Change in winter wheat (Census of Agriculture, 1986 - 1996)
Edmonton
Calgary
Saskatoon
Moose Jaw
Regina
Swift Current
Winnipeg
0 100 200 300 400 Kilometers
Supressed by Statistics Canada
Zero value in 1986
< -100%
-100% to -80%
-80% to 60%
-60% to -40%
-40% to -20%
-20% to 0%
0%
0% - 20%
20% to 40%
40% to 60%
60% to 80%
80% to 100%
> 100%
PHJV Target Area

Figure 34. Percent change of winter wheat area for NAWMP targeted landscapes.

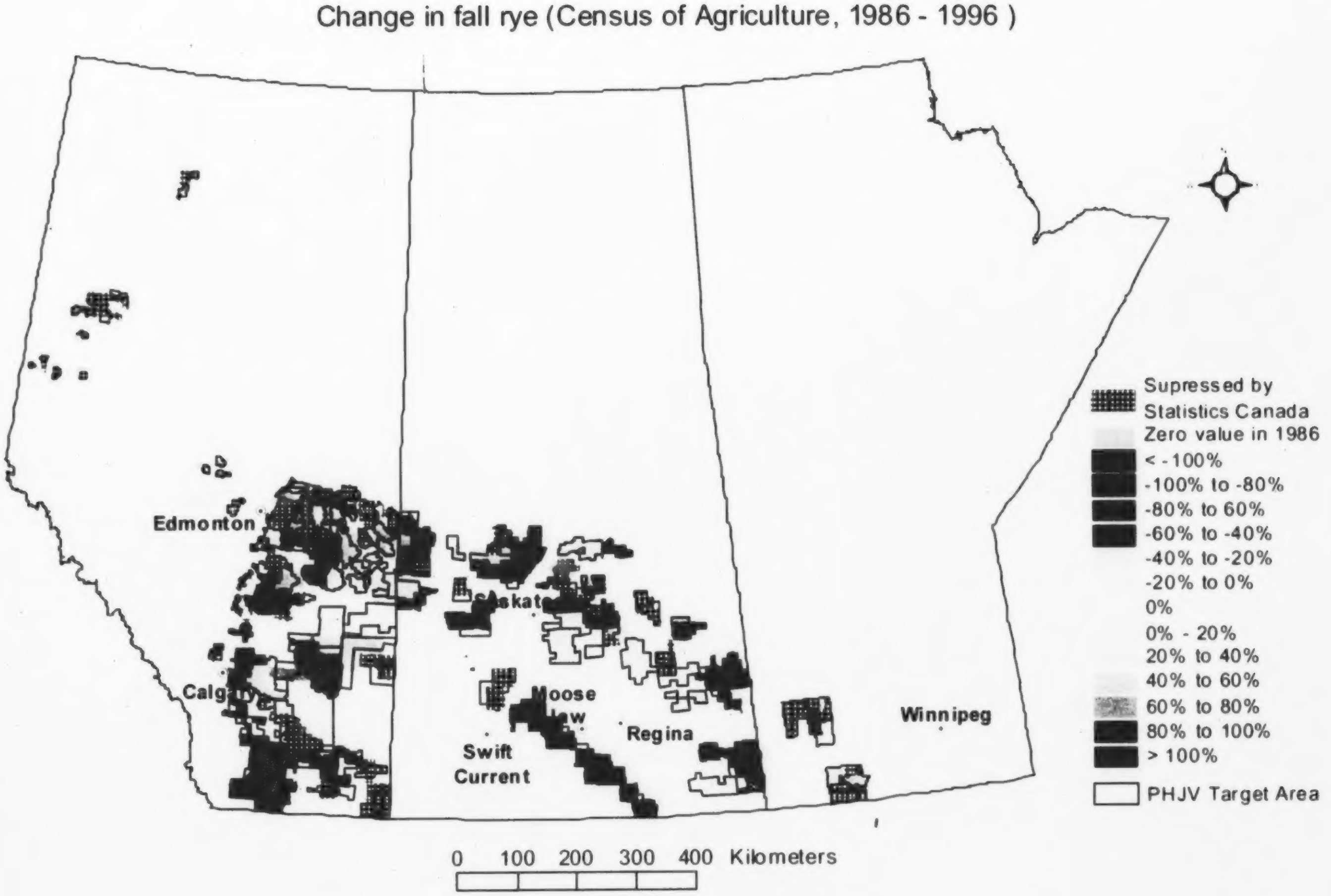
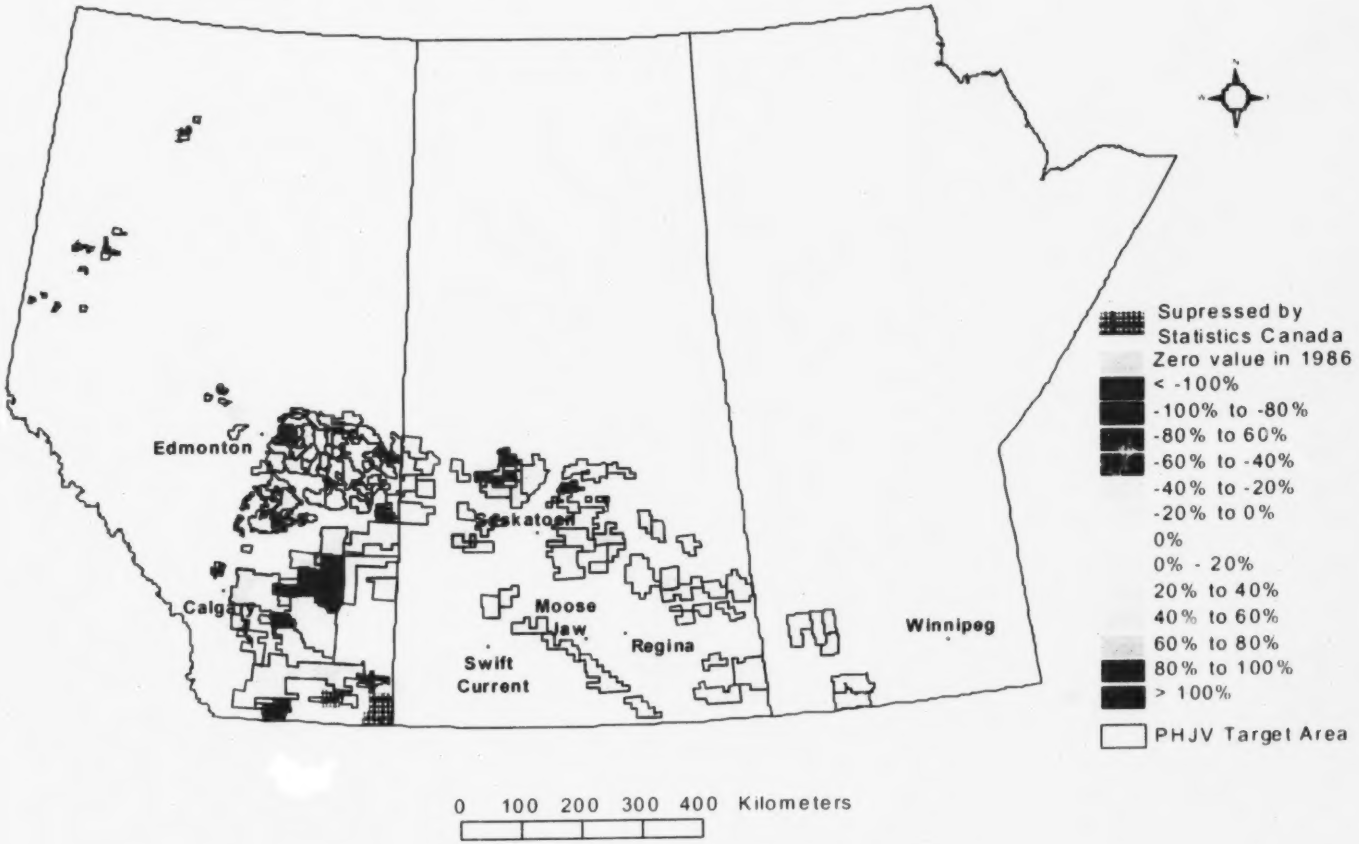

Change in fall rye (Census of Agriculture, 1986 - 1996)
Edmonton
Calg
Saskat
Moose
Jaw
Swift
Current
Regina
Winnipeg
▦ Supressed by Statistics Canada
Zero value in 1986
< -100%
-100% to -80%
-80% to 60%
-60% to -40%
-40% to -20%
-20% to 0%
0%
0% - 20%
20% to 40%
40% to 60%
60% to 80%
80% to 100%
> 100%
☐ PHJV Target Area
0 100 200 300 400 Kilometers

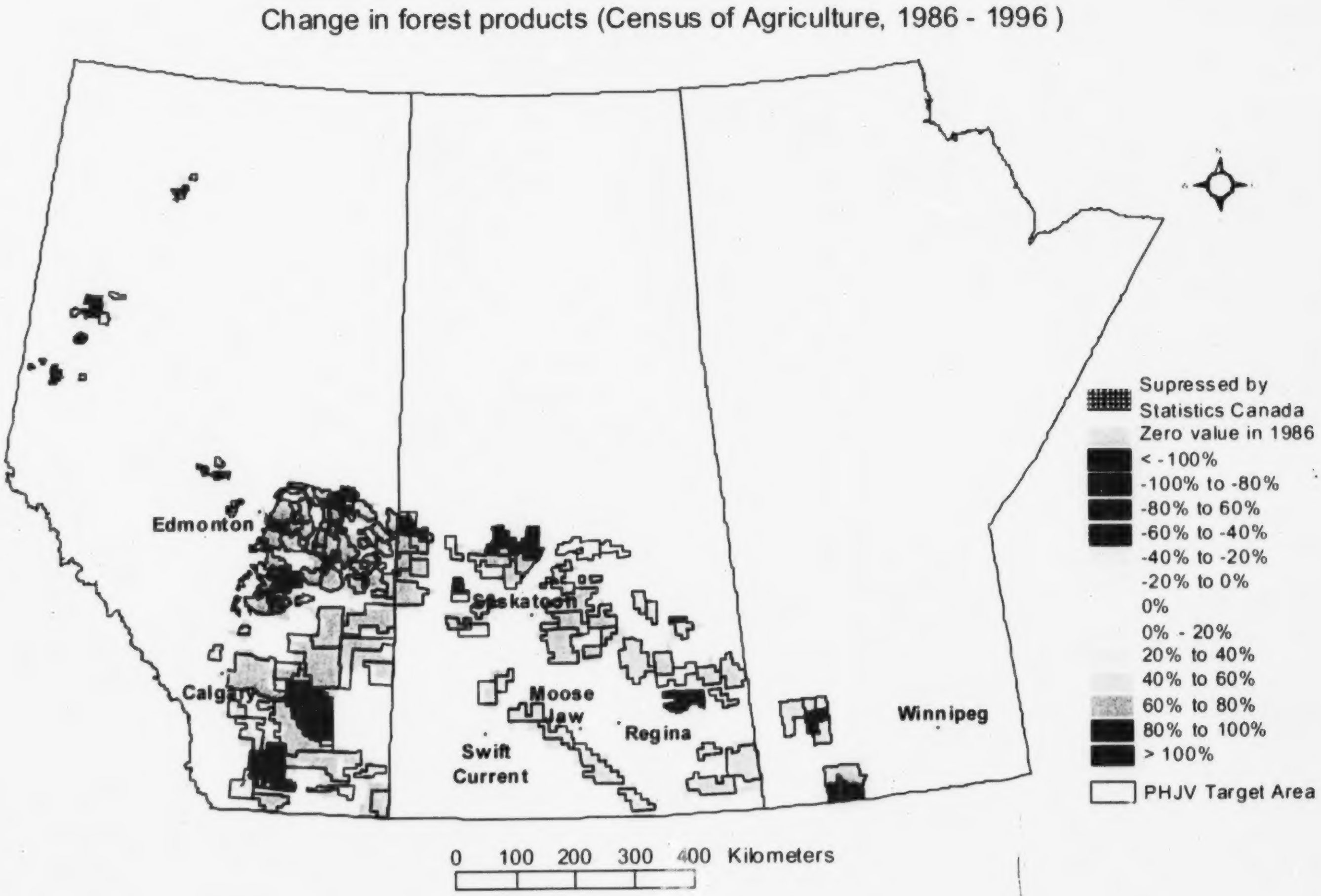
Figure 35. Percent change of fall rye area for NAWMP targeted landscapes.



Change in other unimproved lands (Census of Agriculture, 1986 - 1996)

Edmonton
Calgary
Saskatoon
Moose Jaw
Regina
Swift Current
Winnipeg
Supressed by Statistics Canada
Zero value in 1986
< -100%
-100% to -80%
-80% to 60%
-60% to -40%
-40% to -20%
-20% to 0%
0%
0% - 20%
20% to 40%
40% to 60%
60% to 80%
80% to 100%
> 100%
PHJV Target Area
0 100 200 300 400 Kilometers

Figure 36. Percent change of all other land (includes idle land, wetlands, bogs etc) area for NAWMP targeted landscapes.


Change in forest products (Census of Agriculture, 1986 - 1996)

Edmonton
Calgary
Saskatoon
Moose Jaw
Regina
Swift Current
Winnipeg
0 100 200 300 400 Kilometers
Supressed by Statistics Canada
Zero value in 1986
< -100%
-100% to -80%
-80% to 60%
-60% to -40%
-40% to -20%
-20% to 0%
0%
0% - 20%
20% to 40%
40% to 60%
60% to 80%
80% to 100%
> 100%
PHJV Target Area

Figure 37. Percent change of sales of forest products (Farms Reporting) for NAWMP targeted landscapes.

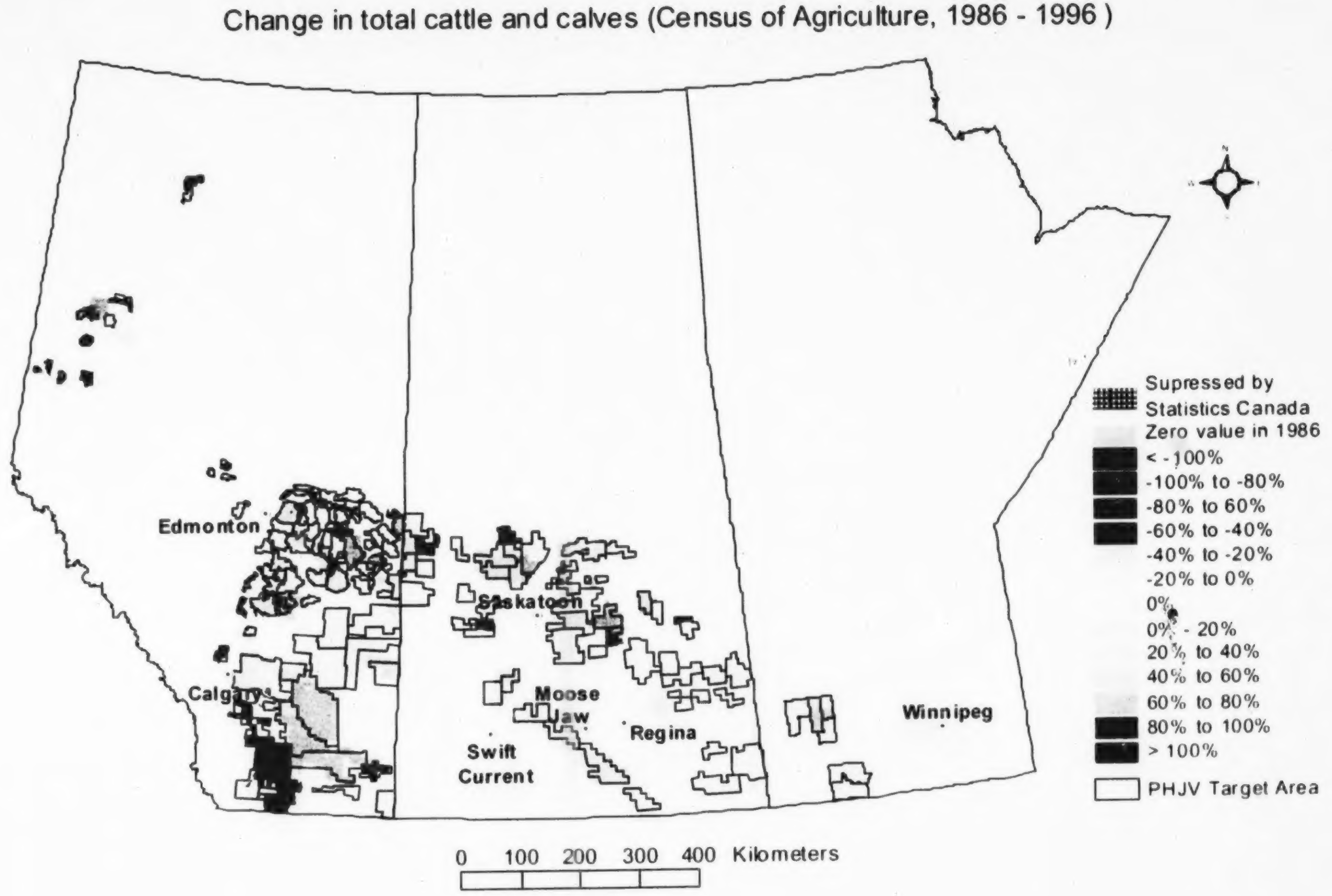

Change in total cattle and calves (Census of Agriculture, 1986 - 1996)
Edmonton
Calgary
Saskatoon
Moose Jaw
Regina
Swift Current
Winnipeg
Supressed by Statistics Canada
Zero value in 1986
< -100%
-100% to -80%
-80% to 60%
-60% to -40%
-40% to -20%
-20% to 0%
0%
0% - 20%
20% to 40%
40% to 60%
60% to 80%
80% to 100%
> 100%
PHJV Target Area
0 100 200 300 400 Kilometers

Figure 38. Percent change of total cattle and calves numbers for NAWMP targeted landscapes.

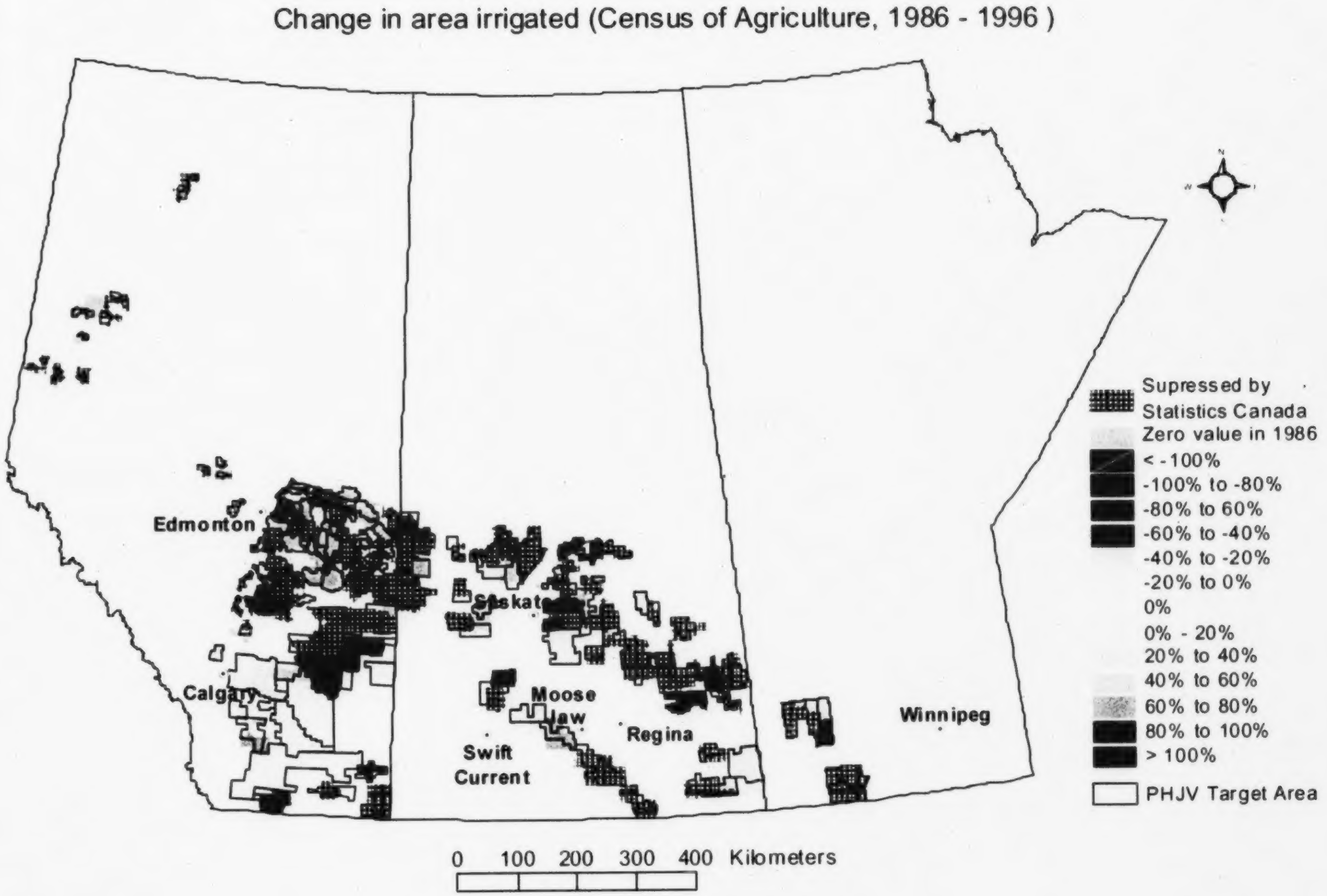

Change in area irrigated (Census of Agriculture, 1986 - 1996)
Edmonton
Calgary
Saskat
Swift Current
Moose Jaw
Regina
Winnipeg
0 100 200 300 400 Kilometers
Supressed by Statistics Canada
Zero value in 1986
< -100%
-100% to -80%
-80% to 60%
-60% to -40%
-40% to -20%
-20% to 0%
0%
0% - 20%
20% to 40%
40% to 60%
60% to 80%
80% to 100%
> 100%
PHJV Target Area

Figure 39. Percent change of irrigated area for NAWMP targeted landscapes.

Table 13. Agricultural Census Data for comparison between targeted and non-targeted landscapes within the PHJV.

1986-1996 CHANGE COMPARISON TARGET AND NON-TARGET, PHJV AREA.

VARIABLE	1986		1996		NON-TARGET		TARGET	
	NON-TARGET	TARGET	NON-TARGET	TARGET	Change	%Change	Change	%Change
Sum of Total area of farms - Farms Reporting	100989	40039	96051	37441	-4938	-5%	-2598	-6%
Sum of Total area of farms - Hectares	37126363	15671872	37408698	15605183	282335	1%	-66689	0%
Sum of Winter wheat - Farms Reporting	6112	1946	871	421	-5241	-86%	-1525	-78%
Sum of Winter wheat - Hectares	388551	132682	61973	33736	-326578	-84%	-98946	-75%
Sum of Fall rye - Farms Reporting	4740	1438	2434	900	-2306	-49%	-538	-37%
Sum of Fall rye - Hectares	185528	55590	102942	35112	-82586	-45%	-20478	-37%
Sum of All tame hay - Farms Reporting	43396	15650	50596	18185	7200	17%	2535	16%
Tame hay- Hectares	1940340	605016	2638648	825587	698308	36%	220571	36%
Forage seed to be harvested for seed- Farms Reporting	1937	349	1607	406	-330	-17%	57	16%
Sum of Forage seed to be harvested for seed - Hectares	102981	17235	112307	25409	9326	9%	8174	47%
Sum of Total area of vegetables - Farms Reporting	534	284	800	307	266	50%	23	8%
Sum of Total area of vegetables - Hectares	2680	2685	3518	3934	838	31%	1249	47%
Sum of Area land in crops - Farms Reporting	94125	37532	86235	33988	-7890	-8%	-3544	-9%
Sum of Area land in crops - Hectares	18542169	7755374	19727238	8137217	1185069	6%	381843	5%
Sum of Summerfallow - Farms Reporting	59272	24862	41680	17535	-17592	-30%	-7327	-29%
Summerfallow - Hectares	5868170	2270199	4480172	1630461	-1387998	-24%	-639738	-28%
Sum of Cultivated Farms Reporting	153397	62394	127915	51523	-25482	-17%	-10871	-17%
Sum of Cultivated Hectares	24410339	10025573	24207410	9767678	-202929	-1%	-257895	-3%
Sum of Tame or seeded pasture - Farms Reporting	27449	11093	33276	13813	5827	21%	2720	25%
Tame or seeded pasture Hectares	1703234	671669	2327840	996515	624606	37%	324846	48%
Sum of Natural land for pasture - Farms Reporting	52482	22899	53769	22357	1287	2%	-542	-2%
Natural land for pasture Hectares	8706001	4064581	8582151	3908100	-123850	-1%	-156481	-4%
Sum of Total area all other land - Farms Reporting	67588	27369	73651	28882	6063	9%	1513	6%
All Other Land - Hectares	2306792	910043	2291303	932890	-15489	-1%	22847	3%
Sum of Area irrigated - Farms Reporting	2739	3769	3076	3818	337	12%	49	1%

1986-1996 CHANGE COMPARISON TARGET AND NON-TARGET, PHJV AREA.

VARIABLE	1986		1996		NON-TARGET		TARGET	
	NON-TARGET	TARGET	NON-TARGET	TARGET	Change	%Change	Change	%Change
Sum of Area irrigated - Hectares	76467	406366	193477	441369	117010	153%	35003	9%
Sum of Total cattle and calves - Farms Reporting	48462	21082	49362	21126	900	2%	44	0%
Sum of Total cattle and calves - Number	4436741	2184284	6257092	3294964	1820351	41%	1110680	51%
Sum of Sales of forest products - Farms Reporting	446	61	1253	142	807	181%	81	133%
Sum of Sales of forest products - Dollars	2789703	137212	23220938	2539059	20431235	732%	2401847	1750%
Sum of Crop rotation - Farms Reporting	30314	10424	63097	26307	32783	108%	15883	152%
Sum of Winter cover crops - Farms Reporting	5911	2295	1245	543	-4666	-79%	-1752	-76%
Sum of Contour cultivation - Farms Reporting	12392	5934	5843	2476	-6549	-53%	-3458	-58%
Sum of Strip-Cropping - Farms Reporting	13777	4281	6376	1960	-7401	-54%	-2321	-54%
Sum of Grassed waterways - Farms Reporting	13348	4596	10331	3475	-3017	-23%	-1121	-24%
Sum of Windbreaks or shelterbelts - Farms Reporting	17936	6300	17675	5874	-261	-1%	-426	-7%
Tillage incorporating residue into soil - Farms Reporting	63780	27034	50615	20480	-13165	-21%	-6554	-24%
Sum of Tillage incorporating residue into soil - Hectares	11390744	5111736	8844579	3749206	-2546165	-22%	-1362530	-27%
Tillage retaining residue on the surface FarmsReporting	21237	8968	24883	11476	3646	17%	2508	28%
Tillage retaining residue on the surface-Hectares	4413914	1970858	5300840	2590785	886926	20%	619927	31%
Sum of No tillage - Farms Reporting	8632	2590	11768	4067	3136	36%	1477	57%
Sum of No tillage - Hectares	1399340	399480	3017339	1027154	1617999	116%	627674	157%
Sum of Chemical weed control - Farms Reporting	3179	1228	4095	1676	916	29%	448	36%
Sum of Chemical weed control - Hectares	235040	88427	403906	147044	168866	72%	58617	66%
Sum of Tillage weed control - Farms Reporting	32761	14175	24657	9234	-8104	-25%	-4941	-35%
Sum of Tillage weed control - Hectares	3179046	1253409	2506846	806598	-672200	-21%	-446811	-36%
Tillage & chemical weed control - Farms Reporting	18556	8098	16077	7738	-2479	-13%	-360	-4%
Sum of Tillage & chemical weed control - Hectares	2165556	782401	1569415	676818	-596141	-28%	-105583	-13%
Sum of Permanent grass cover - Farms Reporting	No Value	No Value	27962	10694	NA	NA	NA	NA

Note: Shaded Indicates 1991 baseline data. White indicates data only available in the 1996 census Year.

1986-1996 CHANGE COMPARISON TARGET AND NON-TARGET, PHJV AREA.

VARIABLE	1986		1996		NON-TARGET		TARGET	
	NON-TARGET	TARGET	NON-TARGET	TARGET	Change	%Change	Change	%Change
Sum of Area irrigated - Hectares	76467	406366	193477	441369	117010	153%	35003	9%
Sum of Total cattle and calves - Farms Reporting	48462	21082	49362	21126	900	2%	44	0%
Sum of Total cattle and calves - Number	4436741	2184284	6257092	3294964	1820351	41%	1110680	51%
Sum of Sales of forest products - Farms Reporting	446	61	1253	142	807	181%	81	133%
Sum of Sales of forest products - Dollars	2789703	137212	23220938	2539059	20431235	732%	2401847	1750%
Sum of Crop rotation - Farms Reporting	30314	10424	63097	26307	32783	108%	15883	152%
Sum of Winter cover crops - Farms Reporting	5911	2295	1245	543	-4666	-79%	-1752	-76%
Sum of Contour cultivation - Farms Reporting	12392	5934	5843	2476	-6549	-53%	-3458	-58%
Sum of Strip-Cropping - Farms Reporting	13777	4281	6376	1960	-7401	-54%	-2321	-54%
Sum of Grassed waterways - Farms Reporting	13348	4596	10331	3475	-3017	-23%	-1121	-24%
Sum of Windbreaks or shelterbelts - Farms Reporting	17936	6300	17675	5874	-261	-1%	-426	-7%
Tillage incorporating residue into soil - Farms Reporting	63780	27034	50615	20480	-13165	-21%	-6554	-24%
Sum of Tillage incorporating residue into soil - Hectares	11390744	5111736	8844579	3749206	-2546165	-22%	-1362530	-27%
Tillage retaining residue on the surface FarmsReporting	21237	8968	24883	11476	3646	17%	2508	28%
Tillage retaining residue on the surface-Hectares	4413914	1970858	5300840	2590785	886926	20%	619927	31%
Sum of No tillage - Farms Reporting	8632	2590	11768	4067	3136	36%	1477	57%
Sum of No tillage - Hectares	1399340	399480	3017339	1027154	1617999	116%	627674	157%
Sum of Chemical weed control - Farms Reporting	3179	1228	4095	1676	916	29%	448	36%
Sum of Chemical weed control - Hectares	235040	88427	403906	147044	168866	72%	58617	66%
Sum of Tillage weed control - Farms Reporting	32761	14175	24657	9234	-8104	-25%	-4941	-35%
Sum of Tillage weed control - Hectares	3179046	1253409	2506846	806598	-672200	-21%	-446811	-36%
Tillage & chemical weed control - Farms Reporting	18556	8098	16077	7738	-2479	-13%	-360	-4%
Sum of Tillage & chemical weed control - Hectares	2165556	782401	1569415	676818	-596141	-28%	-105583	-13%
Sum of Permanent grass cover - Farms Reporting	No Value	No Value	27962	10694	NA	NA	NA	NA

Note: Shaded Indicates 1991 baseline data. White indicates data only available in the 1996 census Year.

Table 14. Agricultural Census Data for comparison between targeted and non-targeted landscapes within the PHJV excluding Peace River Grand Prairie region of Alberta.

1986-1996 CHANGE COMPARISON TARGET AND NON-TARGET, PHJV AREA Excluding Peace River Grand Prairie Region of Alberta.

VARIABLE	1986		1996		NON-TARGET		TARGET	
	NON-TARGET	TARGET	NON-TARGET	TARGET	Change	%Change	Change	%Change
Sum of Total area of farms - Farms Reporting	95123	38726	90423	36373	-4700	-5%	-2353	-6%
Sum of Total area of farms - Hectares	35062474	15266397	35314694	15260979	252220	1%	-5418	0%
Sum of Winter wheat - Farms Reporting	6041	1927	855	418	-5186	-86%	-1509	-78%
Sum of Winter wheat - Hectares	385505	132060	61973	33736	-323532	-84%	-98324	-74%
Sum of Fall rye - Farms Reporting	4700	1427	2407	891	-2293	-49%	-536	-38%
Sum of Fall rye - Hectares	185528	55590	102942	35112	-82586	-45%	-20478	-37%
Sum of All tame hay - Farms Reporting	40834	15086	47146	17480	6312	15%	2394	16%
Tame hay- Hectares	1792620	579203	2397843	785588	605223	34%	206385	36%
Forage seed to be harvested for seed- Farms Reporting	1094	253	894	281	-200	-18%	28	11%
Sum of Forage seed to be harvested for seed - Hectares	48787	11638	50992	17137	2205	5%	5499	47%
Sum of Total area of vegetables - Farms Reporting	515	280	774	303	259	50%	23	8%
Sum of Total area of vegetables - Hectares	2592	2682	3439	3931	847	33%	1249	47%
Sum of Area land in crops - Farms Reporting	88605	36299	81002	32990	-7603	-9%	-3309	-9%
Sum of Area land in crops - Hectares	17492722	7552596	18534111	7947831	1041389	6%	395235	5%
Sum of Summerfallow - Farms Reporting	55689	24039	39767	17178	-15922	-29%	-6861	-29%
Summerfallow - Hectares	5606515	2217526	4353408	1607393	-1253107	-22%	-610133	-28%
Sum of Cultivated Farms Reporting	144294	60338	120769	50168	-23525	-16%	-10170	-17%
Sum of Cultivated Hectares	23099237	9770122	22887519	9555224	-211718	-1%	-214898	-2%
Sum of Tame or seeded pasture - Farms Reporting	25898	10732	31259	13403	5361	21%	2671	25%
Tame or seeded pasture Hectares	1603307	656231	2169492	966328	566185	35%	310097	47%
Sum of Natural land for pasture - Farms Reporting	50332	22351	51411	21841	1079	2%	-510	-2%
Natural land for pasture Hectares	8373398	3988562	8251052	3847522	-122346	-1%	-141040	-4%
Sum of Total area all other land - Farms Reporting	62859	26304	68986	27970	6127	10%	1666	6%
All Other Land - Hectares	1986535	851477	2006637	891904	20102	1%	40427	5%

1986-1996 CHANGE COMPARISON TARGET AND NON-TARGET, PHJV AREA Excluding Peace River Grand Prairie Region of Alberta.

VARIABLE	1986		1996		NON-TARGET		TARGET	
	NON-TARGET	TARGET	NON-TARGET	TARGET	Change	%Change	Change	%Change
Sum of Area irrigated - Farms Reporting	2714	3764	3007	3802	293	11%	38	1%
Sum of Area irrigated - Hectares	76015	406333	192109	440516	116094	153%	34183	8%
Sum of Total cattle and calves - Farms Reporting	46603	20575	47091	20643	488	1%	68	0%
Sum of Total cattle and calves - Number	4313790	2159516	5993042	3250908	1679252	39%	1091392	51%
Sum of Sales of forest products - Farms Reporting	398	45	1071	105	673	169%	60	133%
Sum of Sales of forest products - Dollars	2466157	54655	18515176	1913848	16049019	651%	1859193	3402%
Sum of Crop rotation - Farms Reporting	27135	9836	59460	25649	32325	119%	15813	161%
Sum of Winter cover crops - Farms Reporting	5708	2247	1137	526	-4571	-80%	-1721	-77%
Sum of Contour cultivation - Farms Reporting	11868	5741	5529	2416	-6339	-53%	-3325	-58%
Sum of Strip-Cropping - Farms Reporting	13631	4235	6316	1942	-7315	-54%	-2293	-54%
Sum of Grassed waterways - Farms Reporting	12333	4334	9595	3305	-2738	-22%	-1029	-24%
Sum of Windbreaks or shelterbelts - Farms Reporting	17316	6146	16456	5643	-860	-5%	-503	-8%
Tillage incorporating residue into soil - Farms Reporting	59580	26110	47408	19885	-12172	-20%	-6225	-24%
Sum of Tillage incorporating residue into soil - Hectares	10616285	4960373	8290869	3658958	-2325416	-22%	-1301415	-26%
Tillage retaining residue on the surface FarmsReporting	20450	8820	23660	11243	3210	16%	2423	27%
Tillage retaining residue on the surface-Hectares	4249441	1945429	5026243	2550998	776802	18%	605569	31%
Sum of No tillage - Farms Reporting	8436	2554	11437	4005	3001	36%	1451	57%
Sum of No tillage - Hectares	1383850	396829	2945365	1014785	1561515	113%	617956	156%
Sum of Chemical weed control - Farms Reporting	3084	1209	3923	1633	839	27%	424	35%
Sum of Chemical weed control - Hectares	230002	87840	393504	143490	163502	71%	55650	63%
Sum of Tillage weed control - Farms Reporting	31211	13787	23644	9066	-7567	-24%	-4721	-34%
Sum of Tillage weed control - Hectares	3090856	1233233	2447014	797679	-643842	-21%	-435554	-35%
Tillage & chemical weed control - Farms Reporting	17573	7885	15260	7575	-2313	-13%	-310	-4%
Sum of Tillage & chemical weed control - Hectares	2101648	768403	1513061	666726	-588587	-28%	-101677	-13%
Sum of Permanent grass cover - Farms Reporting	No Value	No Value	26321	10347	NA	NA	NA	NA

Note: Shaded Indicates 1991 baseline data. White indicates data only available in the 1996 census year.

1986-1996 CHANGE COMPARISON TARGET AND NON-TARGET, PHJV AREA Excluding Peace River Grand Prairie Region of Alberta.

VARIABLE	1986		1996		NON-TARGET		TARGET	
	NON-TARGET	TARGET	NON-TARGET	TARGET	Change	%Change	Change	%Change
Sum of Area irrigated - Farms Reporting	2714	3764	3007	3802	293	11%	38	1%
Sum of Area irrigated - Hectares	76015	406333	192109	440516	116094	153%	34183	8%
Sum of Total cattle and calves - Farms Reporting	46603	20575	47091	20643	488	1%	68	0%
Sum of Total cattle and calves - Number	4313790	2159516	5993042	3250908	1679252	39%	1091392	51%
Sum of Sales of forest products - Farms Reporting	398	45	1071	105	673	169%	60	133%
Sum of Sales of forest products - Dollars	2466157	54655	18515176	1913848	16049019	651%	1859193	3402%
Sum of Crop rotation - Farms Reporting	27135	9836	59460	25649	32325	119%	15813	161%
Sum of Winter cover crops - Farms Reporting	5708	2247	1137	526	-4571	-80%	-1721	-77%
Sum of Contour cultivation - Farms Reporting	11868	5741	5529	2416	-6339	-53%	-3325	-58%
Sum of Strip-Cropping - Farms Reporting	13631	4235	6316	1942	-7315	-54%	-2293	-54%
Sum of Grassed waterways - Farms Reporting	12333	4334	9595	3305	-2738	-22%	-1029	-24%
Sum of Windbreaks or shelterbelts - Farms Reporting	17316	6146	16456	5643	-860	-5%	-503	-8%
Tillage incorporating residue into soil - Farms Reporting	59580	26110	47408	19885	-12172	-20%	-6225	-24%
Sum of Tillage incorporating residue into soil - Hectares	10616285	4960373	8290869	3658958	-2325416	-22%	-1301415	-26%
Tillage retaining residue on the surface FarmsReporting	20450	8820	23660	11243	3210	16%	2423	27%
Tillage retaining residue on the surface-Hectares	4249441	1945429	5026243	2550998	776802	18%	605569	31%
Sum of No tillage - Farms Reporting	8436	2554	11437	4005	3001	36%	1451	57%
Sum of No tillage - Hectares	1383850	396829	2945365	1014785	1561515	113%	617956	156%
Sum of Chemical weed control - Farms Reporting	3084	1209	3923	1633	839	27%	424	35%
Sum of Chemical weed control - Hectares	230002	87840	393504	143490	163502	71%	55650	63%
Sum of Tillage weed control - Farms Reporting	31211	13787	23644	9066	-7567	-24%	-4721	-34%
Sum of Tillage weed control - Hectares	3090856	1233233	2447014	797679	-643842	-21%	-435554	-35%
Tillage & chemical weed control - Farms Reporting	17573	7885	15260	7575	-2313	-13%	-310	-4%
Sum of Tillage & chemical weed control - Hectares	2101648	768403	1513061	666726	-588587	-28%	-101677	-13%
Sum of Permanent grass cover - Farms Reporting	No Value	No Value	26321	10347	NA	NA	NA	NA

Note: Shaded indicates 1991 baseline data. White indicates data only available in the 1996 census year.

Table 15. Agricultural Census Data for comparison between targeted and non-targeted landscapes within the PHJV Parkland/Boreal Transition area.

1986-1996 CHANGE COMPARISON TARGET AND NON-TARGET, PHJV AREA PARKLAND/BOREAL TRANSITION

VARIABLE	1986		1996		NON-TARGET		TARGET	
	NON-TARGET	TARGET	NON-TARGET	TARGET	Change	%Change	Change	%Change
Sum of Total area of farms - Farms Reporting	64701	25299	62376	23548	-2325	-4%	-1751	-7%
Sum of Total area of farms - Hectares	18796399	8059953	19061955	8017247	265556	1%	-42706	-1%
Sum of Winter wheat - Farms Reporting	2330	576	468	175	-1862	-80%	-401	-70%
Sum of Winter wheat - Hectares	99692	27757	27384	12201	-72308	-73%	-15556	-56%
Sum of Fall rye - Farms Reporting	2158	652	1475	520	-683	-32%	-132	-20%
Sum of Fall rye - Hectares	63281	19188	56600	18474	-6681	-11%	-714	-4%
Sum of All tame hay - Farms Reporting	32404	9943	37496	11578	5092	16%	1635	16%
Tame hay- Hectares	1450980	347901	1911425	493512	460445	32%	145611	42%
Forage seed to be harvested for seed- Farms Reporting	1013	115	785	104	-228	-23%	-11	-10%
Sum of Forage seed to be harvested for seed - Hectares	40238	4211	40777	6287	539	1%	2076	49%
Sum of Total area of vegetables - Farms Reporting	388	91	596	130	208	54%	39	43%
Sum of Total area of vegetables - Hectares	1809	94	2671	170	862	48%	76	81%
Sum of Area land in crops - Farms Reporting	59490	23719	54873	21338	-4617	-8%	-2381	-10%
Sum of Area land in crops - Hectares	10525650	4554841	11059313	4759035	533663	5%	204194	4%
Sum of Summerfallow - Farms Reporting	30967	15390	20295	10528	-10672	-34%	-4862	-32%
Summerfallow - Hectares	1754011	1027001	1164895	696994	-589116	-34%	-330007	-32%
Sum of Cultivated Farms Reporting	90457	39109	75168	31866	-15289	-17%	-7243	-19%
Sum of Cultivated Hectares	12279661	5581842	12224208	5456029	-55453	0%	-125813	-2%
Sum of Tame or seeded pasture - Farms Reporting	20113	7325	22868	8918	2755	14%	1593	22%
Tame or seeded pasture Hectares	1088556	378543	1426328	558389	337772	31%	179846	48%
Sum of Natural land for pasture - Farms Reporting	34821	15118	36324	14609	1503	4%	-509	-3%
Natural land for pasture Hectares	3777354	1445955	3842735	1350451	65381	2%	-95504	-7%
Sum of Total area all other land - Farms Reporting	47245	18495	50578	18888	3333	7%	393	2%

1986-1996 CHANGE COMPARISON TARGET AND NON-TARGET, PHJV AREA PARKLAND/BOREAL TRANSITION

VARIABLE	1986		1996		NON-TARGET		TARGET	
	NON-TARGET	TARGET	NON-TARGET	TARGET	Change	%Change	Change	%Change
All Other Land - Hectares	1650045	653611	1568687	652377	-81358	-5%	-1234	0%
Sum of Area irrigated - Farms Reporting	573	123	977	249	404	71%	126	102%
Sum of Area irrigated - Hectares	17820	4416	33596	8312	15776	89%	3896	88%
Sum of Total cattle and calves - Farms Reporting	34060	13652	34331	13300	271	1%	-352	-3%
Sum of Total cattle and calves - Number	2991412	1156408	4061458	1592811	1070046	36%	436403	38%
Sum of Sales of forest products - Farms Reporting	378	39	1037	98	659	174%	59	151%
Sum of Sales of forest products - Dollars	2107138	34512	17694081	1620830	15586943	740%	1586318	4596%
Sum of Crop rotation - Farms Reporting	23348	6862	39329	16964	15981	68%	10102	147%
Sum of Winter cover crops - Farms Reporting	3461	1194	828	299	-2633	-76%	-895	-75%
Sum of Contour cultivation - Farms Reporting	7307	3829	3294	1411	-4013	-55%	-2418	-63%
Sum of Strip-Cropping - Farms Reporting	3153	1182	1226	446	-1927	-61%	-736	-62%
Sum of Grassed waterways - Farms Reporting	8862	3095	6669	2255	-2193	-25%	-840	-27%
Sum of Windbreaks or shelterbelts - Farms Reporting	11626	4023	12045	3907	419	4%	-116	-3%
Tillage incorporating residue into soil - Farms Reporting	41833	17618	33083	13171	-8750	-21%	-4447	-25%
Sum of Tillage incorporating residue into soil - Hectares	6799064	3211745	5305083	2310315	-1493981	-22%	-901430	-28%
Tillage retaining residue on the surface FarmsReporting	12043	5258	14224	6950	2181	18%	1692	32%
Tillage retaining residue on the surface-Hectares	2334524	1102976	2814745	1476932	480221	21%	373956	34%
Sum of No tillage - Farms Reporting	3406	1208	4721	2187	1315	39%	979	81%
Sum of No tillage - Hectares	408182	159635	1080613	520782	672431	165%	361147	226%
Sum of Chemical weed control - Farms Reporting	1065	569	1534	870	469	44%	301	53%
Sum of Chemical weed control - Hectares	42440	25366	80706	49037	38266	90%	23671	93%
Sum of Tillage weed control - Farms Reporting	17041	8709	11490	5387	-5551	-33%	-3322	-38%
Sum of Tillage weed control - Hectares	946093	560054	591849	328385	-354244	-37%	-231669	-41%
Tillage & chemical weed control - Farms Reporting	7322	4600	8237	4788	915	12%	188	4%
Sum of Tillage & chemical weed control - Hectares	448082	300636	477106	319570	29024	6%	18934	6%
Sum of Permanent grass cover - Farms Reporting	No Value	No Value	19635	6710	NA	NA	NA	NA

Note: Shaded Indicates 1991 baseline data. White indicates data only available in the 1996 census year.

1986-1996 CHANGE COMPARISON TARGET AND NON-TARGET, PHJV AREA PARKLAND/BOREAL TRANSITION

VARIABLE	1986		1996		NON-TARGET		TARGET	
	NON-TARGET	TARGET	NON-TARGET	TARGET	Change	%Change	Change	%Change
All Other Land - Hectares	1650045	653611	1568687	652377	-81358	-5%	-1234	0%
Sum of Area irrigated - Farms Reporting	573	123	977	249	404	71%	126	102%
Sum of Area irrigated - Hectares	17820	4416	33596	8312	15776	89%	3896	88%
Sum of Total cattle and calves - Farms Reporting	34060	13652	34331	13300	271	1%	-352	-3%
Sum of Total cattle and calves - Number	2991412	1156408	4061458	1592811	1070046	36%	436403	38%
Sum of Sales of forest products - Farms Reporting	378	39	1037	98	659	174%	59	151%
Sum of Sales of forest products - Dollars	2107138	34512	17694081	1620830	15586943	740%	1586318	4596%
Sum of Crop rotation - Farms Reporting	23348	6862	39329	16964	15981	68%	10102	147%
Sum of Winter cover crops - Farms Reporting	3461	1194	828	299	-2633	-76%	-895	-75%
Sum of Contour cultivation - Farms Reporting	7307	3829	3294	1411	-4013	-55%	-2418	-63%
Sum of Strip-Cropping - Farms Reporting	3153	1182	1226	446	-1927	-61%	-736	-62%
Sum of Grassed waterways - Farms Reporting	8862	3095	6669	2255	-2193	-25%	-840	-27%
Sum of Windbreaks or shelterbelts - Farms Reporting	11626	4023	12045	3907	419	4%	-116	-3%
Tillage incorporating residue into soil - Farms Reporting	41833	17618	33083	13171	-8750	-21%	-4447	-25%
Sum of Tillage incorporating residue into soil - Hectares	6799064	3211745	5305083	2310315	-1493981	-22%	-901430	-28%
Tillage retaining residue on the surface FarmsReporting	12043	5258	14224	6950	2181	18%	1692	32%
Tillage retaining residue on the surface-Hectares	2334524	1102976	2814745	1476932	480221	21%	373956	34%
Sum of No tillage - Farms Reporting	3406	1208	4721	2187	1315	39%	979	81%
Sum of No tillage - Hectares	408182	159635	1080613	520782	672431	165%	361147	226%
Sum of Chemical weed control - Farms Reporting	1065	569	1534	870	469	44%	301	53%
Sum of Chemical weed control - Hectares	42440	25366	80706	49037	38266	90%	23671	93%
Sum of Tillage weed control - Farms Reporting	17041	8709	11490	5387	-5551	-33%	-3322	-38%
Sum of Tillage weed control - Hectares	946093	560054	591849	328385	-354244	-37%	-231669	-41%
Tillage & chemical weed control - Farms Reporting	7322	4600	8237	4788	915	12%	188	4%
Sum of Tillage & chemical weed control - Hectares	448082	300636	477106	319570	29024	6%	18934	6%
Sum of Permanent grass cover - Farms Reporting	No Value	No Value	19635	6710	NA	NA	NA	NA

Note: Shaded Indicates 1991 baseline data. White indicates data only available in the 1996 census year.

Table 16. Agricultural Census Data for comparison between targeted and non-targeted landscapes within the PHJV Grasslands area.

1986-1996 CHANGE COMPARISON TARGET AND NON-TARGET, PHJV AREA GRASSLANDS								
VARIABLE	1986		1996		NON-TARGET		TARGET	
	NON-TARGET	TARGET	NON-TARGET	TARGET	Change	%Change	Change	%Change
Sum of Total area of farms - Farms Reporting	30422	13427	28047	12825	-2375	-8%	-602	-4%
Sum of Total area of farms - Hectares	16266075	7206444	16252739	7243732	-13336	0%	37288	1%
Sum of Winter wheat - Farms Reporting	3711	1351	387	243	-3324	-90%	-1108	-82%
Sum of Winter wheat - Hectares	284349	103961	33294	21325	-251055	-88%	-82636	-79%
Sum of Fall rye - Farms Reporting	2542	775	932	371	-1610	-63%	-404	-52%
Sum of Fall rye - Hectares	120386	36143	45152	16435	-75234	-62%	-19708	-55%
Sum of All tame hay - Farms Reporting	8430	5143	9650	5902	1220	14%	759	15%
Tame hay- Hectares	341640	231302	481424	292076	139784	41%	60774	26%
Forage seed to be harvested for seed- Farms Reporting	81	138	109	177	28	35%	39	28%
Sum of Forage seed to be harvested for seed - Hectares	7037	6770	8897	10791	1860	26%	4021	59%
Sum of Total area of vegetables - Farms Reporting	127	189	178	173	51	40%	-16	-8%
Sum of Total area of vegetables - Hectares	606	2561	1164	3761	558	92%	1200	47%
Sum of Area land in crops - Farms Reporting	29115	12580	26129	11652	-2986	-10%	-928	-7%
Sum of Area land in crops - Hectares	6967072	2997755	7474798	3188796	507726	7%	191041	6%
Sum of Summerfallow - Farms Reporting	24722	8649	19472	6650	-5250	-21%	-1999	-23%
Summerfallow - Hectares	3852504	1190525	3188513	910399	-663991	-17%	-280126	-24%
Sum of Cultivated Farms Reporting	53837	21229	45601	18302	-8236	-15%	-2927	-14%
Sum of Cultivated Hectares	10819576	4188280	10663311	4099195	-156265	-1%	-89085	-2%
Sum of Tame or seeded pasture - Farms Reporting	5785	3407	8391	4485	2606	45%	1078	32%
Tame or seeded pasture Hectares	502988	277688	743164	407939	240176	48%	130251	47%
Sum of Natural land for pasture - Farms Reporting	15511	7233	15087	7232	-424	-3%	-1	0%
Natural land for pasture Hectares	4596044	2542607	4408317	2497071	-187727	-4%	-45536	-2%
Sum of Total area all other land - Farms Reporting	15614	7809	18408	9082	2794	18%	1273	16%
All Other Land - Hectares	329117	197866	437950	239527	108833	33%	41661	21%

1986-1996 CHANGE COMPARISON TARGET AND NON-TARGET, PHJV AREA GRASSLANDS

VARIABLE	1986		1996		NON-TARGET		TARGET	
	NON-TARGET	TARGET	NON-TARGET	TARGET	Change	%Change	Change	%Change
Sum of Area irrigated - Farms Reporting	2141	3641	2030	3553	-111	-5%	-88	-2%
Sum of Area irrigated - Hectares	134679	401856	148268	432001	13589	10%	30145	8%
Sum of Total cattle and calves - Farms Reporting	12543	6923	12760	7343	217	2%	420	6%
Sum of Total cattle and calves - Number	1322378	1003108	1931584	1658097	609206	46%	654989	65%
Sum of Sales of forest products - Farms Reporting	20	6	34	7	14	70%	1	17%
Sum of Sales of forest products - Dollars	148802	6500	0	0	-148802	-100%	-6500	-100%
Sum of Crop rotation - Farms Reporting	3787	2974	20131	8685	16344	432%	5711	192%
Sum of Winter cover crops - Farms Reporting	2247	1053	309	227	-1938	-86%	-826	-78%
Sum of Contour cultivation - Farms Reporting	4561	1912	2235	1005	-2326	-51%	-907	-47%
Sum of Strip-Cropping - Farms Reporting	10478	3053	5090	1496	-5388	-51%	-1557	-51%
Sum of Grassed waterways - Farms Reporting	3471	1239	2926	1050	-545	-16%	-189	-15%
Sum of Windbreaks or shelterbelts - Farms Reporting	5690	2123	4411	1736	-1279	-22%	-387	-18%
Tillage incorporating residue into soil - Farms Reporting	17747	8492	14325	6714	-3422	-19%	-1778	-21%
Sum of Tillage incorporating residue into soil - Hectares	3817221	1748628	2985786	1348643	-831435	-22%	-399985	-23%
Tillage retaining residue on the surface FarmsReporting	8407	3562	9436	4293	1029	12%	731	21%
Tillage retaining residue on the surface-Hectares	1914917	842453	2211498	1074066	296581	15%	231613	27%
Sum of No tillage - Farms Reporting	5030	1346	6716	1818	1686	34%	472	35%
Sum of No tillage - Hectares	973760	236276	1863164	484523	889404	91%	248247	105%
Sum of Chemical weed control - Farms Reporting	2019	640	2389	763	370	18%	123	19%
Sum of Chemical weed control - Hectares	186854	62153	310469	93799	123615	66%	31646	51%
Sum of Tillage weed control - Farms Reporting	14170	5078	12154	3679	-2016	-14%	-1399	-28%
Sum of Tillage weed control - Hectares	2144763	673179	1841347	469294	-303416	-14%	-203885	-30%
Tillage & chemical weed control - Farms Reporting	10251	3285	7023	2787	-3228	-31%	-498	-15%
Sum of Tillage & chemical weed control - Hectares	1645701	466654	1033316	346551	-612385	-37%	-120103	-26%
Sum of Permanent grass cover - Farms Reporting	No Value	No Value	6686	3637	NA	NA	NA	NA

Note: Shaded Indicates 1991 baseline data. Red indicates data only available in the 1996 census year.

1986-1996 CHANGE COMPARISON TARGET AND NON-TARGET, PHJV AREA GRASSLANDS

VARIABLE	1986		1996		NON-TARGET		TARGET	
	NON-TARGET	TARGET	NON-TARGET	TARGET	Change	%Change	Change	%Change
Sum of Area irrigated - Farms Reporting	2141	3641	2030	3553	-111	-5%	-88	-2%
Sum of Area irrigated - Hectares	134679	401856	148268	432001	13589	10%	30145	8%
Sum of Total cattle and calves - Farms Reporting	12543	6923	12760	7343	217	2%	420	6%
Sum of Total cattle and calves - Number	1322378	1003108	1931584	1658097	609206	46%	654989	65%
Sum of Sales of forest products - Farms Reporting	20	6	34	7	14	70%	1	17%
Sum of Sales of forest products - Dollars	148802	6500	0	0	-148802	-100%	-6500	-100%
Sum of Crop rotation - Farms Reporting	3787	2974	20131	8685	16344	432%	5711	192%
Sum of Winter cover crops - Farms Reporting	2247	1053	309	227	-1938	-86%	-826	-78%
Sum of Contour cultivation - Farms Reporting	4561	1912	2235	1005	-2326	-51%	-907	-47%
Sum of Strip-Cropping - Farms Reporting	10478	3053	5090	1496	-5388	-51%	-1557	-51%
Sum of Grassed waterways - Farms Reporting	3471	1239	2926	1050	-545	-16%	-189	-15%
Sum of Windbreaks or shelterbelts - Farms Reporting	5690	2123	4411	1736	-1279	-22%	-387	-18%
Tillage incorporating residue into soil - Farms Reporting	17747	8492	14325	6714	-3422	-19%	-1778	-21%
Sum of Tillage incorporating residue into soil - Hectares	3817221	1748628	2985786	1348643	-831435	-22%	-399985	-23%
Tillage retaining residue on the surface FarmsReporting	8407	3562	9436	4293	1029	12%	731	21%
Tillage retaining residue on the surface-Hectares	1914917	842453	2211498	1074066	296581	15%	231613	27%
Sum of No tillage - Farms Reporting	5030	1346	6716	1818	1686	34%	472	35%
Sum of No tillage - Hectares	973760	236276	1863164	484523	889404	91%	248247	105%
Sum of Chemical weed control - Farms Reporting	2019	640	2389	763	370	18%	123	19%
Sum of Chemical weed control - Hectares	186854	62153	310469	93799	123615	66%	31646	51%
Sum of Tillage weed control - Farms Reporting	14170	5078	12154	3679	-2016	-14%	-1399	-28%
Sum of Tillage weed control - Hectares	2144763	673179	1841347	469294	-303416	-14%	-203885	-30%
Tillage & chemical weed control - Farms Reporting	10251	3285	7023	2787	-3228	-31%	-498	-15%
Sum of Tillage & chemical weed control - Hectares	1645701	466654	1033316	346551	-612385	-37%	-120103	-26%
Sum of Permanent grass cover - Farms Reporting	No Value	No Value	6686	3637	NA	NA	NA	NA

Note: Shaded Indicates 1991 baseline data. Red indicates data only available in the 1996 census year.

Table 17. Agricultural Census Data for comparison between targeted and non-targeted landscapes within the PHJV Alberta Peace River and Grand Prairie Area.

1986-1996 CHANGE COMPARISON TARGET AND NON-TARGET, PHJV AREA ALBERTA PEACE RIVER, GRAND PRAIRIE AREA								
VARIABLE	1986		1996		NON-TARGET		TARGET	
	NON-TARGET	TARGET	NON-TARGET	TARGET	Change	%Change	Change	%Change
Sum of Total area of farms - Farms Reporting	5866	1313	5628	1068	-238	-4%	-245	-19%
Sum of Total area of farms - Hectares	2063889	405475	2094004	344204	30115	1%	-61271	-15%
Sum of Winter wheat - Farms Reporting	71	19	16	3	-55	-77%	-16	-84%
Sum of Winter wheat - Hectares	3046	622	0	0	-3046	-100%	-622	-100%
Sum of Fall rye - Farms Reporting	40	11	27	9	-13	-33%	-2	-18%
Sum of Fall rye - Hectares	0	0	0	0	0	0%	0	0%
Sum of All tame hay - Farms Reporting	2562	564	3450	705	888	35%	141	25%
Tame hay- Hectares	147720	25813	240805	39999	93085	63%	14186	55%
Forage seed to be harvested for seed- Farms Reporting	843	96	713	125	-130	-15%	29	30%
Sum of Forage seed to be harvested for seed - Hectares	54194	5597	61315	8272	7121	13%	2675	48%
Sum of Total area of vegetables - Farms Reporting	19	4	26	4	7	37%	0	0%
Sum of Total area of vegetables - Hectares	88	3	79	3	-9	-10%	0	0%
Sum of Area land in crops - Farms Reporting	5520	1233	5233	998	-287	-5%	-235	-19%
Sum of Area land in crops - Hectares	1049447	202778	1193127	189386	143680	14%	-13392	-7%
Sum of Summerfallow - Farms Reporting	3583	823	1913	357	-1670	-47%	-466	-57%
Summerfallow - Hectares	261655	52673	126764	23068	-134891	-52%	-29605	-56%
Sum of Cultivated Farms Reporting	9103	2056	7146	1355	-1957	-21%	-701	-34%
Sum of Cultivated Hectares	1311102	255451	1319891	212454	8789	1%	-42997	-17%
Sum of Tame or seeded pasture - Farms Reporting	1551	361	2017	410	466	30%	49	14%
Tame or seeded pasture Hectares	99927	15438	158348	30187	58421	58%	14749	96%
Sum of Natural land for pasture - Farms Reporting	2150	548	2358	516	208	10%	-32	-6%
Natural land for pasture Hectares	332603	76019	331099	60578	-1504	0%	-15441	-20%
Sum of Total area all other land - Farms Reporting	4729	1065	4665	912	-64	-1%	-153	-14%
All Other Land - Hectares	320257	58566	284666	40986	-35591	-11%	-17580	-30%

1986-1996 CHANGE COMPARISON TARGET AND NON-TARGET, PHJV AREA ALBERTA PEACE RIVER, GRAND PRAIRIE AREA

VARIABLE	1986		1996		NON-TARGET		TARGET	
	NON-TARGET	TARGET	NON-TARGET	TARGET	Change	%Change	Change	%Change
Sum of Area irrigated - Farms Reporting	25	5	69	16	44	176%	11	220%
Sum of Area irrigated - Hectares	452	33	1368	853	916	203%	820	2485%
Sum of Total cattle and calves - Farms Reporting	1859	507	2271	483	412	22%	-24	-5%
Sum of Total cattle and calves - Number	122951	24768	264050	44056	141099	115%	19288	78%
Sum of Sales of forest products - Farms Reporting	48	16	182	37	134	279%	21	131%
Sum of Sales of forest products - Dollars	323546	82557	4705762	625211	4382216	1354%	542654	657%
Sum of Crop rotation - Farms Reporting	3179	588	3637	658	458	14%	70	12%
Sum of Winter cover crops - Farms Reporting	203	48	108	17	-95	-47%	-31	-65%
Sum of Contour cultivation - Farms Reporting	524	193	314	60	-210	-40%	-133	-69%
Sum of Strip-Cropping - Farms Reporting	146	46	60	18	-86	-59%	-28	-61%
Sum of Grassed waterways - Farms Reporting	1015	262	736	170	-279	-27%	-92	-35%
Sum of Windbreaks or shelterbelts - Farms Reporting	620	154	1219	231	599	97%	77	50%
Tillage incorporating residue into soil - Farms Reporting	4200	924	3207	595	-993	-24%	-329	-36%
Sum of Tillage incorporating residue into soil - Hectares	774459	151363	553710	90248	-220749	-29%	-61115	-40%
Tillage retaining residue on the surface FarmsReporting	787	148	1223	233	436	55%	85	57%
Tillage retaining residue on the surface-Hectares	164473	25429	274597	39787	110124	67%	14358	56%
Sum of No tillage - Farms Reporting	196	36	331	62	135	69%	26	72%
Sum of No tillage - Hectares	15490	2651	71974	12369	56484	365%	9718	367%
Sum of Chemical weed control - Farms Reporting	95	19	172	43	77	81%	24	126%
Sum of Chemical weed control - Hectares	5038	587	10402	3554	5364	106%	2967	505%
Sum of Tillage weed control - Farms Reporting	1550	388	1013	168	-537	-35%	-220	-57%
Sum of Tillage weed control - Hectares	88190	20176	59832	8919	-28358	-32%	-11257	-56%
Tillage & chemical weed control - Farms Reporting	983	213	817	163	-166	-17%	-50	-23%
Sum of Tillage & chemical weed control - Hectares	63908	13998	56354	10092	-7554	-12%	-3906	-28%
Sum of Permanent grass cover - Farms Reporting	No Value	No Value	1641	347	NA	NA	NA	NA

Note: Shaded Indicates 1991 baseline data. White indicates data only available in the 1996 census year.

1986-1996 CHANGE COMPARISON TARGET AND NON-TARGET, PHJV AREA ALBERTA PEACE RIVER, GRAND PRAIRIE AREA

VARIABLE	1986		1996		NON-TARGET		TARGET	
	NON-TARGET	TARGET	NON-TARGET	TARGET	Change	%Change	Change	%Change
Sum of Area irrigated - Farms Reporting	25	5	69	16	44	176%	11	220%
Sum of Area irrigated - Hectares	452	33	1368	853	916	203%	820	2485%
Sum of Total cattle and calves - Farms Reporting	1859	507	2271	483	412	22%	-24	-5%
Sum of Total cattle and calves - Number	122951	24768	264050	44056	141099	115%	19288	78%
Sum of Sales of forest products - Farms Reporting	48	16	182	37	134	279%	21	131%
Sum of Sales of forest products - Dollars	323546	82557	4705762	625211	4382216	1354%	542654	657%
Sum of Crop rotation - Farms Reporting	3179	588	3637	658	458	14%	70	12%
Sum of Winter cover crops - Farms Reporting	203	48	108	17	-95	-47%	-31	-65%
Sum of Contour cultivation - Farms Reporting	524	193	314	60	-210	-40%	-133	-69%
Sum of Strip-Cropping - Farms Reporting	146	46	60	18	-86	-59%	-28	-61%
Sum of Grassed waterways - Farms Reporting	1015	262	736	170	-279	-27%	-92	-35%
Sum of Windbreaks or shelterbelts - Farms Reporting	620	154	1219	231	599	97%	77	50%
Tillage incorporating residue into soil - Farms Reporting	4200	924	3207	595	-993	-24%	-329	-36%
Sum of Tillage incorporating residue into soil - Hectares	774459	151363	553710	90248	-220749	-29%	-61115	-40%
Tillage retaining residue on the surface FarmsReporting	787	148	1223	233	436	55%	85	57%
Tillage retaining residue on the surface-Hectares	164473	25429	274597	39787	110124	67%	14358	56%
Sum of No tillage - Farms Reporting	196	36	331	62	135	69%	26	72%
Sum of No tillage - Hectares	15490	2651	71974	12369	56484	365%	9718	367%
Sum of Chemical weed control - Farms Reporting	95	19	172	43	77	81%	24	126%
Sum of Chemical weed control - Hectares	5038	587	10402	3554	5364	106%	2967	505%
Sum of Tillage weed control - Farms Reporting	1550	388	1013	168	-537	-35%	-220	-57%
Sum of Tillage weed control - Hectares	88190	20176	59832	8919	-28358	-32%	-11257	-56%
Tillage & chemical weed control - Farms Reporting	983	213	817	163	-166	-17%	-50	-23%
Sum of Tillage & chemical weed control - Hectares	63908	13998	56354	10092	-7554	-12%	-3906	-28%
Sum of Permanent grass cover - Farms Reporting	No Value	No Value	1641	347	NA	NA	NA	NA

Note: Shaded indicates 1991 baseline data. White indicates data only available in the 1996 census year.

Table 18. Agricultural Census Data for comparison between targeted and non-targeted landscapes within the PHJV Alberta Parkland/Boreal Transition area.

1986-1996 CHANGE COMPARISON TARGET AND NON-TARGET, PHJV AREA ALBERTA PARKLAND/BOREAL TRANSITION AREA								
VARIABLE	1986		1996		NON TARGET		TARGET	
	NON-TARGET	TARGET	NON-TARGET	TARGET	Change	%Change	Change	%Change
Sum of Total area of farms - Farms Reporting	23100	10974	24665	10879	1565	7%	-95	-1%
Sum of Total area of farms - Hectares	5662463	3239898	5933859	3235205	271396	5%	-4693	0%
Sum of Winter wheat - Farms Reporting	151	53	59	25	-92	-61%	-28	-53%
Sum of Winter wheat - Hectares	3860	2178	2028	1309	-1832	-47%	-869	-40%
Sum of Fall rye - Farms Reporting	449	260	242	194	-207	-46%	-66	-25%
Sum of Fall rye - Hectares	10954	8323	6563	6856	-4391	-40%	-1467	-18%
Sum of All tame hay - Farms Reporting	15114	5513	17793	6122	2679	18%	609	11%
Tame hay- Hectares	752247	213196	918177	268463	165930	22%	55267	26%
Forage seed to be harvested for seed- Farms Reporting	227	19	189	29	-38	-17%	10	53%
Sum of Forage seed to be harvested for seed - Hectares	8703	528	10204	1053	1501	17%	525	99%
Sum of Total area of vegetables - Farms Reporting	146	55	210	80	64	44%	25	45%
Sum of Total area of vegetables - Hectares	466	70	584	112	118	25%	42	60%
Sum of Area land in crops - Farms Reporting	20697	9963	20476	9321	-221	-1%	-642	-6%
Sum of Area land in crops - Hectares	2726324	1779516	2845153	1805323	118829	4%	25807	1%
Sum of Summerfallow - Farms Reporting	7387	5184	4276	3129	-3111	-42%	-2055	-40%
Summerfallow - Hectares	302316	308258	187707	181553	-114609	-38%	-126705	-41%
Sum of Cultivated Farms Reporting	28084	15147	24752	12450	-3332	-12%	-2697	-18%
Sum of Cultivated Hectares	3028640	2087774	3032860	1986876	4220	0%	-100898	-5%
Sum of Tame or seeded pasture - Farms Reporting	10567	4330	11575	4970	1008	10%	640	15%
Tame or seeded pasture Hectares	584131	242612	756057	347496	171926	29%	104884	43%
Sum of Natural land for pasture - Farms Reporting	13581	6990	15811	7348	2230	16%	358	5%
Natural land for pasture Hectares	1473617	674363	1614700	667746	141083	10%	-6617	-1%
Sum of Total area all other land - Farms Reporting	17262	7971	20079	8621	2817	16%	650	8%

1986-1996 CHANGE COMPARISON TARGET AND NON-TARGET, PHJV AREA ALBERTA PARKLAND/BOREAL TRANSITION AREA

VARIABLE	1986		1996		NON-TARGET		TARGET	
	NON-TARGET	TARGET	NON-TARGET	TARGET	Change	%Change	Change	%Change
All Other Land - Hectares	576077	235149	530244	233086	-45833	-8%	-2063	-1%
Sum of Area irrigated - Farms Reporting	193	63	360	136	167	87%	73	116%
Sum of Area irrigated - Hectares	3965	1234	10513	4710	6548	165%	3476	282%
Sum of Total cattle and calves - Farms Reporting	14613	6903	16061	7091	1448	10%	188	3%
Sum of Total cattle and calves - Number	1514432	687604	2202697	992469	688265	45%	304865	44%
Sum of Sales of forest products - Farms Reporting	173	15	688	57	515	298%	42	280%
Sum of Sales of forest products - Dollars	680169	17410	13337478	1121844	12657309	1861%	1104434	6344%
Sum of Crop rotation - Farms Reporting	10651	3487	12709	6739	2058	19%	3252	93%
Sum of Winter cover crops - Farms Reporting	1022	538	377	166	-645	-63%	-372	-69%
Sum of Contour cultivation - Farms Reporting	1937	1467	1079	580	-858	-44%	-887	-60%
Sum of Strip-Cropping - Farms Reporting	609	367	344	159	-265	-44%	-208	-57%
Sum of Grassed waterways - Farms Reporting	3849	1476	2922	1085	-927	-24%	-391	-26%
Sum of Windbreaks or shelterbelts - Farms Reporting	3879	2049	5033	2072	1154	30%	23	1%
Tillage incorporating residue into soil - Farms Reporting	14891	7304	11952	5627	-2939	-20%	-1677	-23%
Sum of Tillage incorporating residue into soil - Hectares	1706030	1224711	1258046	896491	-447984	-26%	-328220	-27%
Tillage retaining residue on the surface FarmsReporting	2666	1856	3477	2471	811	30%	615	33%
Tillage retaining residue on the surface-Hectares	387259	384762	515561	504725	128302	33%	119963	31%
Sum of No tillage - Farms Reporting	447	224	900	688	453	101%	464	207%
Sum of No tillage - Hectares	27422	25255	158720	149398	131298	479%	124143	492%
Sum of Chemical weed control - Farms Reporting	199	154	387	275	188	94%	121	79%
Sum of Chemical weed control - Hectares	5695	5598	19710	13507	14015	246%	7909	141%
Sum of Tillage weed control - Farms Reporting	3845	2520	2514	1572	-1331	-35%	-948	-38%
Sum of Tillage weed control - Hectares	137412	140300	92855	82286	-44557	-32%	-58014	-41%
Tillage & chemical weed control - Farms Reporting	1520	1467	1562	1426	42	3%	-41	-3%
Sum of Tillage & chemical weed control - Hectares	66853	85636	75140	85759	8287	12%	123	0%
Sum of Permanent grass cover - Farms Reporting	No Value	No Value	10043	4013	NA	NA	NA	NA

Note: Shaded Indicates 1991 baseline data. White indicates data only available in the 1996 census year.

1986-1996 CHANGE COMPARISON TARGET AND NON-TARGET, PHJV AREA ALBERTA PARKLAND/BOREAL TRANSITION AREA

VARIABLE	1986		1996		NON-TARGET		TARGET	
	NON-TARGET	TARGET	NON-TARGET	TARGET	Change	%Change	Change	%Change
All Other Land - Hectares	576077	235149	530244	233086	-45833	-8%	-2063	-1%
Sum of Area irrigated - Farms Reporting	193	63	360	136	167	87%	73	116%
Sum of Area irrigated - Hectares	3965	1234	10513	4710	6548	165%	3476	282%
Sum of Total cattle and calves - Farms Reporting	14613	6903	16061	7091	1448	10%	188	3%
Sum of Total cattle and calves - Number	1514432	687604	2202697	992469	688265	45%	304865	44%
Sum of Sales of forest products - Farms Reporting	173	15	688	57	515	298%	42	280%
Sum of Sales of forest products - Dollars	680169	17410	13337478	1121844	12657309	1861%	1104434	6344%
Sum of Crop rotation - Farms Reporting	10651	3487	12709	6739	2058	19%	3252	93%
Sum of Winter cover crops - Farms Reporting	1022	538	377	166	-645	-63%	-372	-69%
Sum of Contour cultivation - Farms Reporting	1937	1467	1079	580	-858	-44%	-887	-60%
Sum of Strip-Cropping - Farms Reporting	609	367	344	159	-265	-44%	-208	-57%
Sum of Grassed waterways - Farms Reporting	3849	1476	2922	1085	-927	-24%	-391	-26%
Sum of Windbreaks or shelterbelts - Farms Reporting	3879	2049	5033	2072	1154	30%	23	1%
Tillage incorporating residue into soil - Farms Reporting	14891	7304	11952	5627	-2939	-20%	-1677	-23%
Sum of Tillage incorporating residue into soil - Hectares	1706030	1224711	1258046	896491	-447984	-26%	-328220	-27%
Tillage retaining residue on the surface FarmsReporting	2666	1856	3477	2471	811	30%	615	33%
Tillage retaining residue on the surface-Hectares	387259	384762	515561	504725	128302	33%	119963	31%
Sum of No tillage - Farms Reporting	447	224	900	688	453	101%	464	207%
Sum of No tillage - Hectares	27422	25255	158720	149398	131298	479%	124143	492%
Sum of Chemical weed control - Farms Reporting	199	154	387	275	188	94%	121	79%
Sum of Chemical weed control - Hectares	5695	5598	19710	13507	14015	246%	7909	141%
Sum of Tillage weed control - Farms Reporting	3845	2520	2514	1572	-1331	-35%	-948	-38%
Sum of Tillage weed control - Hectares	137412	140300	92855	82286	-44557	-32%	-58014	-41%
Tillage & chemical weed control - Farms Reporting	1520	1467	1562	1426	42	3%	-41	-3%
Sum of Tillage & chemical weed control - Hectares	66853	85636	75140	85759	8287	12%	123	0%
Sum of Permanent grass cover - Farms Reporting	No Value	No Value	[illegible]	[illegible]	NA	NA	NA	NA

Note: Shaded indicates 1991 baseline data. White indicates data only available in the 1996 census year.

Table 19. Agricultural Census Data for comparison between targeted and non-targeted landscapes within the PHJV Alberta Grassland area.

1986-1996 CHANGE COMPARISON TARGET AND NON-TARGET, PHJV AREA ALBERTA GRASSLAND AREA								
VARIABLE	1986		1996		NON-TARGET		TARGET	
	NON-TARGET	TARGET	NON-TARGET	TARGET	Change	%Change	Change	Change
Sum of Total area of farms - Farms Reporting	6280	7902	6363	8030	83	1%	128	2%
Sum of Total area of farms - Hectares	3929821	4622386	3914818	4660261	-15003	0%	37875	1%
Sum of Winter wheat - Farms Reporting	1004	829	208	197	-796	-79%	-632	-76%
Sum of Winter wheat - Hectares	94437	75444	16947	16647	-77490	-82%	-58797	-78%
Sum of Fall rye - Farms Reporting	570	459	204	215	-366	-64%	-244	-53%
Sum of Fall rye - Hectares	23839	23370	7891	10159	-15948	-67%	-13211	-57%
Sum of All tame hay - Farms Reporting	2405	3675	2923	4292	518	22%	617	17%
Tame hay- Hectares	104886	180276	148119	215454	43233	41%	35178	20%
Forage seed to be harvested for seed- Farms Reporting	22	128	39	155	17	77%	27	21%
Sum of Forage seed to be harvested for seed - Hectares	2206	6357	3198	9691	992	45%	3334	52%
Sum of Total area of vegetables - Farms Reporting	47	184	78	161	31	66%	-23	-13%
Sum of Total area of vegetables - Hectares	372	2553	980	3739	608	163%	1186	46%
Sum of Area land in crops - Farms Reporting	5711	7210	5420	7003	-291	-5%	-207	-3%
Sum of Area land in crops - Hectares	1448752	1790770	1508102	1845525	59350	4%	54755	3%
Sum of Summerfallow - Farms Reporting	3816	3863	2821	2993	-995	-26%	-870	-23%
Summerfallow - Hectares	610289	565413	457630	442118	-152659	-25%	-123295	-22%
Sum of Cultivated Farms Reporting	9527	11073	8241	9996	-1286	-13%	-1077	-10%
Sum of Cultivated Hectares	2059041	2356183	1965732	2287643	-93309	-5%	-68540	-3%
Sum of Tame or seeded pasture - Farms Reporting	1764	2439	2377	3092	613	35%	653	27%
Tame or seeded pasture Hectares	142652	205735	224256	306324	81604	57%	100589	49%
Sum of Natural land for pasture - Farms Reporting	4036	4112	4244	4452	208	5%	340	8%
Natural land for pasture Hectares	1647453	1963324	1614060	1951889	-33393	-2%	-11435	-1%
Sum of Total area all other land - Farms Reporting	3475	4530	4284	5510	809	23%	980	22%

1986-1996 CHANGE COMPARISON TARGET AND NON-TARGET, PHJV AREA ALBERTA GRASSLAND AREA

VARIABLE	1986		1996		NON-TARGET		TARGET	
	NON-TARGET	TARGET	NON-TARGET	TARGET	Change	%Change	Change	%Change
All Other Land - Hectares	80675	97141	110773	114406	30098	37%	17265	18%
Sum of Area irrigated - Farms Reporting	796	3540	825	3475	29	4%	-65	-2%
Sum of Area irrigated - Hectares	64017	396221	75415	423572	11398	18%	27351	7%
Sum of Total cattle and calves - Farms Reporting	3718	4475	4060	5054	342	9%	579	13%
Sum of Total cattle and calves - Number	537893	815113	838528	1410734	300635	56%	595621	73%
Sum of Sales of forest products - Farms Reporting	6	6	20	5	14	233%	-1	-17%
Sum of Sales of forest products - Dollars	0	6500	0	0	0	0%	-6500	-100%
Sum of Crop rotation - Farms Reporting	1066	2208	3552	4767	2486	233%	2559	116%
Sum of Winter cover crops - Farms Reporting	687	770	121	172	-566	-82%	-598	-78%
Sum of Contour cultivation - Farms Reporting	659	760	378	500	-281	-43%	-260	-34%
Sum of Strip-Cropping - Farms Reporting	1846	1759	932	1009	-914	-50%	-750	-43%
Sum of Grassed waterways - Farms Reporting	849	741	783	650	-66	-8%	-91	-12%
Sum of Windbreaks or shelterbelts - Farms Reporting	950	1109	975	1032	25	3%	-77	-7%
Tillage incorporating residue into soil - Farms Reporting	3577	4853	2853	4042	-724	-20%	-811	-17%
Sum of Tillage incorporating residue into soil - Hectares	838200	1021601	636189	825096	-202011	-24%	-196505	-19%
Tillage retaining residue on the surface FarmsReporting	1677	1979	1956	2280	279	17%	301	15%
Tillage retaining residue on the surface-Hectares	442829	520828	537961	612962	95132	21%	92134	18%
Sum of No tillage - Farms Reporting	520	521	734	702	214	41%	181	35%
Sum of No tillage - Hectares	79951	96966	193686	185984	113735	142%	89018	92%
Sum of Chemical weed control - Farms Reporting	289	304	346	359	57	20%	55	18%
Sum of Chemical weed control - Hectares	29633	38190	54191	50448	24558	83%	12258	32%
Sum of Tillage weed control - Farms Reporting	2023	2122	1636	1644	-387	-19%	-478	-23%
Sum of Tillage weed control - Hectares	334057	299071	255926	226443	-78131	-23%	-72628	-24%
Tillage & chemical weed control - Farms Reporting	1497	1383	1164	1274	-333	-22%	-109	-8%
Sum of Tillage & chemical weed control - Hectares	218027	203372	144131	164472	-73896	-34%	-38900	-19%
Sum of Permanent grass cover - Farms Reporting	No Value	No Value	2286	2709	NA	NA	NA	NA

Note: Shaded Indicates 1991 baseline data. White indicates data only available in the 1996 census year.

1986-1996 CHANGE COMPARISON TARGET AND NON-TARGET, PHJV AREA ALBERTA GRASSLAND AREA

VARIABLE	1986		1996		NON-TARGET		TARGET	
	NON-TARGET	TARGET	NON-TARGET	TARGET	Change	%Change	Change	%Change
All Other Land - Hectares	80675	97141	110773	114406	30098	37%	17265	18%
Sum of Area irrigated - Farms Reporting	796	3540	825	3475	29	4%	-65	-2%
Sum of Area irrigated - Hectares	64017	396221	75415	423572	11398	18%	27351	7%
Sum of Total cattle and calves - Farms Reporting	3718	4475	4060	5054	342	9%	579	13%
Sum of Total cattle and calves - Number	537893	815113	838528	1410734	300635	56%	595621	73%
Sum of Sales of forest products - Farms Reporting	6	6	20	5	14	233%	-1	-17%
Sum of Sales of forest products - Dollars	0	6500	0	0	0	0%	-6500	-100%
Sum of Crop rotation - Farms Reporting	1066	2208	3552	4767	2486	233%	2559	116%
Sum of Winter cover crops - Farms Reporting	687	770	121	172	-566	-82%	-598	-78%
Sum of Contour cultivation - Farms Reporting	659	760	378	500	-281	-43%	-260	-34%
Sum of Strip-Cropping - Farms Reporting	1846	1759	932	1009	-914	-50%	-750	-43%
Sum of Grassed waterways - Farms Reporting	849	741	783	650	-66	-8%	-91	-12%
Sum of Windbreaks or shelterbelts - Farms Reporting	950	1109	975	1032	25	3%	-77	-7%
Tillage incorporating residue into soil - Farms Reporting	3577	4853	2853	4042	-724	-20%	-811	-17%
Sum of Tillage incorporating residue into soil - Hectares	838200	1021601	636189	825096	-202011	-24%	-196505	-19%
Tillage retaining residue on the surface FarmsReporting	1677	1979	1956	2280	279	17%	301	15%
Tillage retaining residue on the surface-Hectares	442829	520828	537961	612962	95132	21%	92134	18%
Sum of No tillage - Farms Reporting	520	521	734	702	214	41%	181	35%
Sum of No tillage - Hectares	79951	96966	193686	185984	113735	142%	89018	92%
Sum of Chemical weed control - Farms Reporting	289	304	346	359	57	20%	55	18%
Sum of Chemical weed control - Hectares	29633	38190	54191	50448	24558	83%	12258	32%
Sum of Tillage weed control - Farms Reporting	2023	2122	1636	1644	-387	-19%	-478	-23%
Sum of Tillage weed control - Hectares	334057	299071	255926	226443	-78131	-23%	-72628	-24%
Tillage & chemical weed control - Farms Reporting	1497	1383	1164	1274	-333	-22%	-109	-8%
Sum of Tillage & chemical weed control - Hectares	218027	203372	144131	164472	-73896	-34%	-38900	-19%
Sum of Permanent grass cover - Farms Reporting	No Value	No Value	2286	2709	NA	NA	NA	NA

Note: Shaded Indicates 1991 baseline data. White indicates data only available in the 1996 census year.

Table 20. Agricultural Census Data for comparison between targeted and non-targeted landscapes within the PHJV Manitoba Parkland/Boreal Transition area.

1986-1996 CHANGE COMPARISON TARGET AND NON-TARGET, PHJV AREA MANITOBA PARKLAND/BOREAL TRANSITION AREA								
VARIABLE	1986		1996		NON-TARGET		TARGET	
	NON-TARGET	TARGET	NON-TARGET	TARGET	Change	%Change	Change	%Change
Sum of Total area of farms - Farms Reporting	20232	2486	18353	2116	-1879	-9%	-370	-15%
Sum of Total area of farms - Hectares	5703732	740849	5727722	720722	23990	0%	-20127	-3%
Sum of Winter wheat - Farms Reporting	424	30	149	24	-275	-65%	-6	-20%
Sum of Winter wheat - Hectares	21478	1192	9457	891	-12021	-56%	-301	-25%
Sum of Fall rye - Farms Reporting	830	27	655	55	-175	-21%	28	104%
Sum of Fall rye - Hectares	26892	612	29105	1290	2213	8%	678	111%
Sum of All tame hay - Farms Reporting	9170	968	10458	1249	1288	14%	281	29%
Tame hay- Hectares	385088	29371	513395	52816	128307	33%	23445	80%
Forage seed to be harvested for seed- Farms Reporting	231	10	175	9	-56	-24%	-1	-10%
Sum of Forage seed to be harvested for seed - Hectares	8271	314	6381	305	-1890	-23%	-9	-3%
Sum of Total area of vegetables - Farms Reporting	186	9	265	7	79	42%	-2	-22%
Sum of Total area of vegetables - Hectares	1238	0	1869	5	631	51%	5	NA
Sum of Area land in crops - Farms Reporting	18305	2327	16129	1969	-2176	-12%	-358	-15%
Sum of Area land in crops - Hectares	3563942	478460	3672657	486352	108715	3%	7892	2%
Sum of Summerfallow - Farms Reporting	8171	1260	5479	908	-2692	-33%	-352	-28%
Summerfallow - Hectares	343261	56437	234404	40507	-108857	-32%	-15930	-28%
Sum of Cultivated Farms Reporting	26476	3587	21608	2877	-4868	-18%	-710	-20%
Sum of Cultivated Hectares	3907203	534897	3907061	526859	-142	0%	-8038	-2%
Sum of Tame or seeded pasture - Farms Reporting	4549	498	5092	650	543	12%	152	31%
Tame or seeded pasture Hectares	200459	15039	257953	23650	57494	29%	8611	57%
Sum of Natural land for pasture - Farms Reporting	10139	1590	10170	1345	31	0%	-245	-15%
Natural land for pasture Hectares	1143922	107113	1110848	93351	-33074	-3%	-13762	-13%
Sum of Total area all other land - Farms Reporting	14445	1874	14844	1824	399	3%	-50	-3%
All Other Land - Hectares	452150	83800	451859	76861	-291	0%	-6939	-8%

1986-1996 CHANGE COMPARISON TARGET AND NON-TARGET, PHJV AREA MANITOBA PARKLAND/BOREAL TRANSITION AREA

VARIABLE	1986		1996		NON-TARGET		TARGET	
	NON-TARGET	TARGET	NON-TARGET	TARGET	Change	%Change	Change	%Change
Sum of Area irrigated - Farms Reporting	231	15	389	13	158	68%	-2	-13%
Sum of Area irrigated - Hectares	7846	1619	11046	0	3200	41%	-1619	-100%
Sum of Total cattle and calves - Farms Reporting	10087	1289	9464	1191	-623	-6%	-98	-8%
Sum of Total cattle and calves - Number	810293	83802	997331	105974	187038	23%	22172	26%
Sum of Sales of forest products - Farms Reporting	90	7	131	9	41	46%	2	29%
Sum of Sales of forest products - Dollars	461987	0	483381	10085	21394	5%	10085	NA
Sum of Crop rotation - Farms Reporting	6188	672	11587	1593	5399	87%	921	137%
Sum of Winter cover crops - Farms Reporting	1397	105	191	26	-1206	-86%	-79	-75%
Sum of Contour cultivation - Farms Reporting	2294	297	1057	145	-1237	-54%	-152	-51%
Sum of Strip-Cropping - Farms Reporting	921	59	355	27	-566	-61%	-32	-54%
Sum of Grassed waterways - Farms Reporting	2260	407	1792	321	-468	-21%	-86	-21%
Sum of Windbreaks or shelterbelts - Farms Reporting	4395	364	3777	382	-618	-14%	18	5%
Tillage incorporating residue into soil - Farms Reporting	11977	1572	9908	1207	-2069	-17%	-365	-23%
Sum of Tillage incorporating residue into soil - Hectares	2196416	304233	2028738	251642	-167678	-8%	-52591	-17%
Tillage retaining residue on the surface FarmsReporting	4708	646	4252	625	-456	-10%	-21	-3%
Tillage retaining residue on the surface-Hectares	974128	145281	862560	141072	-111568	-11%	-4209	-3%
Sum of No tillage - Farms Reporting	1465	169	1477	278	12	1%	109	64%
Sum of No tillage - Hectares	177544	18756	287619	44896	110075	62%	26140	139%
Sum of Chemical weed control - Farms Reporting	180	30	339	58	159	88%	28	93%
Sum of Chemical weed control - Hectares	4939	533	12657	2205	7718	156%	1672	314%
Sum of Tillage weed control - Farms Reporting	3975	681	3320	531	-655	-16%	-150	-22%
Sum of Tillage weed control - Hectares	152303	28852	139677	24560	-12626	-8%	-4292	-15%
Tillage & chemical weed control - Farms Reporting	1283	292	2047	370	764	60%	78	27%
Sum of Tillage & chemical weed control - Hectares	44782	10029	79550	13741	34768	78%	3712	37%
Sum of Permanent grass cover - Farms Reporting	No Value	No Value	5093	572	NA	NA	NA	NA

Note: Shaded Indicates 1991 baseline data. White indicates data only available in the 1996 census year.

1986-1996 CHANGE COMPARISON TARGET AND NON-TARGET, PHJV AREA MANITOBA PARKLAND/BOREAL TRANSITION AREA								
VARIABLE	1986		1996		NON-TARGET		TARGET	
	NON-TARGET	TARGET	NON-TARGET	TARGET	Change	%Change	Change	%Change
Sum of Area irrigated - Farms Reporting	231	15	389	13	158	68%	-2	-13%
Sum of Area irrigated - Hectares	7846	1619	11046	0	3200	41%	-1619	-100%
Sum of Total cattle and calves - Farms Reporting	10087	1289	9464	1191	-623	-6%	-98	-8%
Sum of Total cattle and calves - Number	810293	83802	997331	105974	187038	23%	22172	26%
Sum of Sales of forest products - Farms Reporting	90	7	131	9	41	46%	2	29%
Sum of Sales of forest products - Dollars	461987	0	483381	10085	21394	5%	10085	NA
Sum of Crop rotation - Farms Reporting	6188	672	11587	1593	5399	87%	921	137%
Sum of Winter cover crops - Farms Reporting	1397	105	191	26	-1206	-86%	-79	-75%
Sum of Contour cultivation - Farms Reporting	2294	297	1057	145	-1237	-54%	-152	-51%
Sum of Strip-Cropping - Farms Reporting	921	59	355	27	-566	-61%	-32	-54%
Sum of Grassed waterways - Farms Reporting	2260	407	1792	321	-468	-21%	-86	-21%
Sum of Windbreaks or shelterbelts - Farms Reporting	4395	364	3777	382	-618	-14%	18	5%
Tillage incorporating residue into soil - Farms Reporting	11977	1572	9908	1207	-2069	-17%	-365	-23%
Sum of Tillage incorporating residue into soil - Hectares	2196416	304233	2028738	251642	-167678	-8%	-52591	-17%
Tillage retaining residue on the surface FarmsReporting	4708	646	4252	625	-456	-10%	-21	-3%
Tillage retaining residue on the surface-Hectares	974128	145281	862560	141072	-111568	-11%	-4209	-3%
Sum of No tillage - Farms Reporting	1465	169	1477	278	12	1%	109	64%
Sum of No tillage - Hectares	177544	18756	287619	44896	110075	62%	26140	139%
Sum of Chemical weed control - Farms Reporting	180	30	339	58	159	88%	28	93%
Sum of Chemical weed control - Hectares	4939	533	12657	2205	7718	156%	1672	314%
Sum of Tillage weed control - Farms Reporting	3975	681	3320	531	-655	-16%	-150	-22%
Sum of Tillage weed control - Hectares	152303	28852	139677	24560	-12626	-8%	-4292	-15%
Tillage & chemical weed control - Farms Reporting	1283	292	2047	370	764	60%	78	27%
Sum of Tillage & chemical weed control - Hectares	44782	10029	79550	13741	34768	78%	3712	37%
Sum of Permanent grass cover - Farms Reporting	No Value	No Value	5093	572	NA	NA	NA	NA

Note: Shaded Indicates 1991 baseline data. White indicates data only available in the 1996 census year.

Table 21. Agricultural Census Data for comparison between targeted and non-targeted landscapes within the PHJV Saskatchewan Parkland/Boreal Transition area.

1986-1996 CHANGE COMPARISON TARGET AND NON-TARGET, PHJV AREA SASKATCHEWAN PARKLAND/BOREAL TRANSITION AREA								
VARIABLE	1986		1996		NON-TARGET		TARGET	
	NON-TARGET	TARGET	NON-TARGET	TARGET	Change	%Change	Change	%Change
Sum of Total area of farms - Farms Reporting	21369	11839	19358	10553	-2011	-9%	-1286	-11%
Sum of Total area of farms - Hectares	7430204	4079206	7400374	4061320	-29830	0%	-17886	0%
Sum of Winter wheat - Farms Reporting	1755	493	260	126	-1495	-85%	-367	-74%
Sum of Winter wheat - Hectares	74354	24387	15899	10001	-58455	-79%	-14386	-59%
Sum of Fall rye - Farms Reporting	879	365	578	271	-301	-34%	-94	-26%
Sum of Fall rye - Hectares	25435	10253	20932	10328	-4503	-18%	75	1%
Sum of All tame hay - Farms Reporting	8120	3462	9245	4207	1125	14%	745	22%
Tame hay- Hectares	313645	105334	479853	172233	166208	53%	66899	64%
Forage seed to be harvested for seed- Farms Reporting	555	86	421	66	-134	-24%	-20	-23%
Sum of Forage seed to be harvested for seed - Hectares	23264	3369	24192	4929	928	4%	1560	46%
Sum of Total area of vegetables - Farms Reporting	56	27	121	43	65	116%	16	59%
Sum of Total area of vegetables - Hectares	105	24	218	53	113	108%	29	121%
Sum of Area land in crops - Farms Reporting	20488	11429	18268	10048	-2220	-11%	-1381	-12%
Sum of Area land in crops - Hectares	4235384	2296865	4541503	2467360	306119	7%	170495	7%
Sum of Summerfallow - Farms Reporting	15409	8946	10540	6491	-4869	-32%	-2455	-27%
Summerfallow - Hectares	1108434	662306	742784	474934	-365650	-33%	-187372	-28%
Sum of Cultivated Farms Reporting	35897	20375	28808	16539	-7089	-20%	-3836	-19%
Sum of Cultivated Hectares	5343818	2959171	5284287	2942294	-59531	-1%	-16877	-1%
Sum of Tame or seeded pasture - Farms Reporting	4997	2497	6201	3298	1204	24%	801	32%
Tame or seeded pasture Hectares	303966	120892	412318	187243	108352	36%	66351	55%
Sum of Natural land for pasture - Farms Reporting	11101	6538	10343	5916	-758	-7%	-622	-10%
Natural land for pasture Hectares	1159815	664479	1117187	589354	-42628	-4%	-75125	-11%
Sum of Total area all other land - Farms Reporting	15538	8650	15655	8443	117	1%	-207	-2%
All Other Land - Hectares	621818	334662	586584	342430	-35234	-6%	7768	2%

1986-1996 CHANGE COMPARISON TARGET AND NON-TARGET, PHJV AREA SASKATCHEWAN

PARKLAND/BOREAL TRANSITION AREA

VARIABLE	1986		1996		NON-TARGET		TARGET	
	NON-TARGET	TARGET	NON-TARGET	TARGET	Change	%Change	Change	%Change
Sum of Area irrigated - Farms Reporting	149	45	228	100	79	53%	55	122%
Sum of Area irrigated - Hectares	6009	1563	12037	3602	6028	100%	2039	130%
Sum of Total cattle and calves - Farms Reporting	9360	5460	8806	5018	-554	-6%	-442	-8%
Sum of Total cattle and calves - Number	666687	385002	861430	494368	194743	29%	109366	28%
Sum of Sales of forest products - Farms Reporting	115	17	218	32	103	90%	15	88%
Sum of Sales of forest products - Dollars	964982	17102	3873222	488901	2908240	301%	471799	2759%
Sum of Crop rotation - Farms Reporting	6509	2703	15033	8632	8524	131%	5929	219%
Sum of Winter cover crops - Farms Reporting	1042	551	260	107	-782	-75%	-444	-81%
Sum of Contour cultivation - Farms Reporting	3076	2065	1158	686	-1918	-62%	-1379	-67%
Sum of Strip-Cropping - Farms Reporting	1623	756	527	260	-1096	-68%	-496	-66%
Sum of Grassed waterways - Farms Reporting	2753	1212	1955	849	-798	-29%	-363	-30%
Sum of Windbreaks or shelterbelts - Farms Reporting	3352	1610	3235	1453	-117	-3%	-157	-10%
Tillage incorporating residue into soil - Farms Reporting	14965	8742	11223	6337	-3742	-25%	-2405	-28%
Sum of Tillage incorporating residue into soil - Hectares	2896618	1682801	2018299	1162182	-878319	-30%	-520619	-31%
Tillage retaining residue on the surface FarmsReporting	4669	2756	6495	3854	1826	39%	1098	40%
Tillage retaining residue on the surface-Hectares	973137	572933	1436624	831135	463487	48%	258202	45%
Sum of No tillage - Farms Reporting	1494	815	2344	1221	850	57%	406	50%
Sum of No tillage - Hectares	203216	115624	634274	326488	431058	212%	210864	182%
Sum of Chemical weed control - Farms Reporting	686	385	808	537	122	18%	152	39%
Sum of Chemical weed control - Hectares	31806	19235	48339	33325	16533	52%	14090	73%
Sum of Tillage weed control - Farms Reporting	9221	5508	5656	3284	-3565	-39%	-2224	-40%
Sum of Tillage weed control - Hectares	656378	390902	359317	221539	-297061	-45%	-169363	-43%
Tillage & chemical weed control - Farms Reporting	4519	2841	4628	2992	109	2%	151	5%
Sum of Tillage & chemical weed control - Hectares	336447	204971	322416	220070	-14031	-4%	15099	7%
Sum of Permanent grass cover - Farms Reporting	No Value	No Value	4499	2125	NA	NA	NA	NA

Note: Shaded Indicates 1991 baseline data. White indicates data only available in the 1996 census year.

1986-1996 CHANGE COMPARISON TARGET AND NON-TARGET, PHJV AREA SASKATCHEWAN PARKLAND/BOREAL TRANSITION AREA

VARIABLE	1986		1996		NON-TARGET		TARGET	
	NON-TARGET	TARGET	NON-TARGET	TARGET	Change	%Change	Change	%Change
Sum of Area irrigated - Farms Reporting	149	45	228	100	79	53%	55	122%
Sum of Area irrigated - Hectares	6009	1563	12037	3602	6028	100%	2039	130%
Sum of Total cattle and calves - Farms Reporting	9360	5460	8806	5018	-554	-6%	-442	-8%
Sum of Total cattle and calves - Number	666687	385002	861430	494368	194743	29%	109366	28%
Sum of Sales of forest products - Farms Reporting	115	17	218	32	103	90%	15	88%
Sum of Sales of forest products - Dollars	964982	17102	3873222	488901	2908240	301%	471799	2759%
Sum of Crop rotation - Farms Reporting	6509	2703	15033	8632	8524	131%	5929	219%
Sum of Winter cover crops - Farms Reporting	1042	551	260	107	-782	-75%	-444	-81%
Sum of Contour cultivation - Farms Reporting	3076	2065	1158	686	-1918	-62%	-1379	-67%
Sum of Strip-Cropping - Farms Reporting	1623	756	527	260	-1096	-68%	-496	-66%
Sum of Grassed waterways - Farms Reporting	2753	1212	1955	849	-798	-29%	-363	-30%
Sum of Windbreaks or shelterbelts - Farms Reporting	3352	1610	3235	1453	-117	-3%	-157	-10%
Tillage incorporating residue into soil - Farms Reporting	14965	8742	11223	6337	-3742	-25%	-2405	-28%
Sum of Tillage incorporating residue into soil - Hectares	2896618	1682801	2018299	1162182	-878319	-30%	-520619	-31%
Tillage retaining residue on the surface FarmsReporting	4669	2756	6495	3854	1826	39%	1098	40%
Tillage retaining residue on the surface-Hectares	973137	572933	1436624	831135	463487	48%	258202	45%
Sum of No tillage - Farms Reporting	1494	815	2344	1221	850	57%	406	50%
Sum of No tillage - Hectares	203216	115624	634274	326488	431058	212%	210864	182%
Sum of Chemical weed control - Farms Reporting	686	385	808	537	122	18%	152	39%
Sum of Chemical weed control - Hectares	31806	19235	48339	33325	16533	52%	14090	73%
Sum of Tillage weed control - Farms Reporting	9221	5508	5656	3284	-3565	-39%	-2224	-40%
Sum of Tillage weed control - Hectares	656378	390902	359317	221539	-297061	-45%	-169363	-43%
Tillage & chemical weed control - Farms Reporting	4519	2841	4628	2992	109	2%	151	5%
Sum of Tillage & chemical weed control - Hectares	336447	204971	322416	220070	-14031	-4%	15099	7%
Sum of Permanent grass cover - Farms Reporting	No Value	No Value	4499	2125	NA	NA	NA	NA

Note: Shaded Indicates 1991 baseline data. White indicates data only available in the 1996 census year.

Table 22. Agricultural Census Data for comparison between targeted and non-targeted landscapes within the PHJV Saskatchewan Grassland area.

1986-1996 CHANGE COMPARISON TARGET AND NON-TARGET, PHJV AREA SASKATCHEWAN GRASSLAND AREA

VARIABLE	1986		1996		NON TARGET		TARGET	
	NON-TARGET	TARGET	NON-TARGET	TARGET	Change	%Change	Change	%Change
Sum of Total area of farms - Farms Reporting	24142	5525	21684	4795	-2458	-10%	-730	-13%
Sum of Total area of farms - Hectares	12336254	2584058	12337921	2583471	1667	0%	-587	0%
Sum of Winter wheat - Farms Reporting	2707	522	179	46	-2528	-93%	-476	-91%
Sum of Winter wheat - Hectares	189912	28517	16347	4678	-173565	-91%	-23839	-84%
Sum of Fall rye - Farms Reporting	1972	316	728	156	-1244	-63%	-160	-51%
Sum of Fall rye - Hectares	96547	12773	37261	6276	-59286	-61%	-6497	-51%
Sum of All tame hay - Farms Reporting	6025	1468	6727	1610	702	12%	142	10%
Tame hay- Hectares	236754	51026	333305	76622	96551	41%	25596	50%
Forage seed to be harvested for seed- Farms Reporting	59	10	70	22	11	19%	12	120%
Sum of Forage seed to be harvested for seed - Hectares	4831	413	5699	1100	868	18%	687	166%
Sum of Total area of vegetables - Farms Reporting	80	5	100	12	20	25%	7	140%
Sum of Total area of vegetables - Hectares	234	8	184	22	-50	-21%	14	175%
Sum of Area land in crops - Farms Reporting	23404	5370	20709	4649	-2695	-12%	-721	-13%
Sum of Area land in crops - Hectares	5518320	1206985	5966696	1343271	448376	8%	136286	11%
Sum of Summerfallow - Farms Reporting	20906	4786	16651	3657	-4255	-20%	-1129	-24%
Summerfallow - Hectares	3242215	625112	2730883	468281	-511332	-16%	-156831	-25%
Sum of Cultivated Farms Reporting	44310	10156	37360	8306	-6950	-16%	-1850	-18%
Sum of Cultivated Hectares	8760535	1832097	8697579	1811552	-62956	-1%	-20545	-1%
Sum of Tame or seeded pasture - Farms Reporting	4021	968	6014	1393	1993	50%	425	44%
Tame or seeded pasture Hectares	360336	71953	518908	101615	158572	44%	29662	41%
Sum of Natural land for pasture - Farms Reporting	11475	3121	10843	2780	-632	-6%	-341	-11%
Natural land for pasture Hectares	2948591	579283	2794257	545182	-154334	-5%	-34101	-6%
Sum of Total area all other land - Farms Reporting	12139	3279	14124	3572	1985	16%	293	9%
All Other Land - Hectares	248442	100725	327177	125121	78735	32%	24396	24%

1986-1996 CHANGE COMPARISON TARGET AND NON-TARGET, PHJV AREA SASKATCHEWAN GRASSLAND AREA								
VARIABLE	1986		1996		NON-TARGET		TARGET	
	NON-TARGET	TARGET	NON-TARGET	TARGET	Change	%Change	Change	%Change
Sum of Area irrigated - Farms Reporting	1345	101	1205	78	-140	-10%	-23	-23%
Sum of Area irrigated - Hectares	70662	5635	72853	8429	2191	3%	2794	50%
Sum of Total cattle and calves - Farms Reporting	8825	2448	8700	2289	-125	-1%	-159	-6%
Sum of Total cattle and calves - Number	784485	187995	1093056	247363	308571	39%	59368	32%
Sum of Sales of forest products - Farms Reporting	14	0	14	2	0	0%	[illegible]	NA
Sum of Sales of forest products - Dollars	148802	0	0	0	-148802	-100%	0	0%
Sum of Crop rotation - Farms Reporting	2721	766	16579	3918	13858	509%	3152	411%
Sum of Winter cover crops - Farms Reporting	1560	283	188	55	-1372	-88%	-228	-81%
Sum of Contour cultivation - Farms Reporting	3902	1152	1857	505	-2045	-52%	-647	-56%
Sum of Strip-Cropping - Farms Reporting	8632	1294	4158	487	-4474	-52%	-807	-62%
Sum of Grassed waterways - Farms Reporting	2622	498	2143	400	-479	-18%	-98	-20%
Sum of Windbreaks or shelterbelts - Farms Reporting	4740	1014	3436	704	-1304	-28%	-310	-31%
Tillage incorporating residue into soil - Farms Reporting	14170	3639	11472	2672	-2698	-19%	-967	-27%
Sum of Tillage incorporating residue into soil - Hectares	2979021	727027	2349597	523547	-629424	-21%	-203480	-28%
Tillage retaining residue on the surface FarmsReporting	6730	1583	7480	2013	750	11%	430	27%
Tillage retaining residue on the surface-Hectares	1472088	321625	1673537	461104	201449	14%	139479	43%
Sum of No tillage - Farms Reporting	4510	825	5982	1116	1472	33%	291	35%
Sum of No tillage - Hectares	893809	139310	1669478	298539	775669	87%	159229	114%
Sum of Chemical weed control - Farms Reporting	1730	336	2043	404	313	18%	68	20%
Sum of Chemical weed control - Hectares	157221	23963	256278	43351	99057	63%	19388	81%
Sum of Tillage weed control - Farms Reporting	12147	2956	10518	2035	-1629	-13%	-921	-31%
Sum of Tillage weed control - Hectares	1810706	374108	1585421	242851	-225285	-12%	-131257	-35%
Tillage & chemical weed control - Farms Reporting	8754	1902	5859	1513	-2895	-33%	-389	-20%
Sum of Tillage & chemical weed control - Hectares	1427674	263282	889185	182079	-538489	-38%	-81203	-31%
Sum of Permanent grass cover - Farms Reporting	No Value	No Value	4400	928	NA	NA	NA	NA

Note: Shaded Indicates 1991 baseline data. White indicates data only available in the 1996 census year.

1986-1996 CHANGE COMPARISON TARGET AND NON-TARGET, PHJV AREA SASKATCHEWAN GRASSLAND AREA

VARIABLE	1986		1996		NON TARGET		TARGET	
	NON-TARGET	TARGET	NON-TARGET	TARGET	Change	%Change	Change	%Change
Sum of Area irrigated - Farms Reporting	1345	101	1205	78	-140	-10%	-23	-23%
Sum of Area irrigated - Hectares	70662	5635	72853	8429	2191	3%	2794	50%
Sum of Total cattle and calves - Farms Reporting	8825	2448	8700	2289	-125	-1%	-159	-6%
Sum of Total cattle and calves - Number	784485	187995	1093056	247363	308571	39%	59368	32%
Sum of Sales of forest products - Farms Reporting	14	0	14	2	0	0%	2	NA
Sum of Sales of forest products - Dollars	148802	0	0	0	-148802	-100%	0	0%
Sum of Crop rotation - Farms Reporting	2721	766	16579	3918	13858	509%	3152	411%
Sum of Winter cover crops - Farms Reporting	1560	283	188	55	-1372	-88%	-228	-81%
Sum of Contour cultivation - Farms Reporting	3902	1152	1857	505	-2045	-52%	-647	-56%
Sum of Strip-Cropping - Farms Reporting	8632	1294	4158	487	-4474	-52%	-807	-62%
Sum of Grassed waterways - Farms Reporting	2622	498	2143	400	-479	-18%	-98	-20%
Sum of Windbreaks or shelterbelts - Farms Reporting	4740	1014	3436	704	-1304	-28%	-310	-31%
Tillage incorporating residue into soil - Farms Reporting	14170	3639	11472	2672	-2698	-19%	-967	-27%
Sum of Tillage incorporating residue into soil - Hectares	2979021	727027	2349597	523547	-629424	-21%	-203480	-28%
Tillage retaining residue on the surface FarmsReporting	6730	1583	7480	2013	750	11%	430	27%
Tillage retaining residue on the surface-Hectares	1472088	321625	1673537	461104	201449	14%	139479	43%
Sum of No tillage - Farms Reporting	4510	825	5982	1116	1472	33%	291	35%
Sum of No tillage - Hectares	893809	139310	1669478	298539	775669	87%	159229	114%
Sum of Chemical weed control - Farms Reporting	1730	336	2043	404	313	18%	68	20%
Sum of Chemical weed control - Hectares	157221	23963	256278	43351	99057	63%	19388	81%
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Tillage & chemical weed control - Farms Reporting	8754	1902	5859	1513	-2895	-33%	-389	-20%
Sum of Tillage & chemical weed control - Hectares	1427674	263282	889185	182079	-538489	-38%	-81203	-31%
Sum of Permanent grass cover - Farms Reporting	No Value	No Value	4400	928	NA	NA	NA	NA

Note: Shaded Indicates 1991 baseline data. White indicates data only available in the 1996 census year.

REFERENCES

Agriculture and Agri-Food Canada. Prairie Agricultural Landscapes. A Land Resource Review. Catalogue No. A98-3/4-2000E 2000

Avery, T.E. 1968 (second edition). Interpretation of Aerial Photographs. Burgess Publishing Co., Minneapolis, MN. 324 pp.

Dahl, T.E. 2000. Status and Trends of Wetlands in the Conterminous United States 1986 to 1997. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. 82pp.

Federal Geographic Data Committee. 1992. Application of Satellite Data for Mapping and Monitoring Wetlands - Fact Finding Report; Technical Report 1. Wetlands Subcommittee, FGDC. Washington, D.C. 32 pp plus Appendices.

Fowler, D. Brian 1997. Winter Wheat Production Manual. Ducks Unlimited Canada, CPS Conservation Production System Ltd., Saskatoon, Saskatchewan

Hiley, J.C. and A. Richard. 1995. A comparison of estimates of agricultural land use using satellite imagery and Census of agriculture inventories. Edmonton: Agriculture and Agri-Food Canada. Centre for Land and Biological Resources Research Contribution. No. 95-72. 53 pages.

Kazmerik, B. 2001. Ducks Unlimited Canada. Digital data provided included PHJV boundary, targeted landscapes, DU intensive quarter sections intersecting sampled quarter sections, DU priority 30 + pair polygons, and pintail priority areas.

Ignatiuk, Jordan and Dave C. Duncan. 1995. Wetland Loss in Aspen Parkland of Saskatchewan. Blue Jay 53(3) September 1995.

Ingstrup, D. and H. Schinke. 1999. Prairie Habitat Monitoring Program Update: Preliminary Results. Draft. 23p.

Kiel, W.H. Jr., A.S. Hawkins and N.G. Perret. 1972. Waterfowl habitat trends in the aspen parkland of Manitoba. Can. Wildl. Serv. Report Series No 18. 61 pp.

Lillesand, T.M. and R.W. Kiefer. 1987 (second edition) Remote Sensing and Image Interpretation. John Wiley and Sons, Inc., New York, NY. 721 pp.

Lynch Stewart, P. 1983. Land use change on wetlands in southern Canada: review and bibliography. Canada land use monitoring program. Lands Directorate. Environment Canada. Working Paper No. 26

Millar, J.B. 1984. Classification of wetlands on air/ground comparison transects in the Prairie Provinces. Part III. Waterfowl Strata 26 to 29 - Saskatchewan. Can. Wild. Serv. Unpubl. Rep., 77 pp.

Millar, J.B. 1986. Estimates of habitat distribution in the settled portions of the Prairie Provinces in 1982. Can. Wildl. Serv. Unpubl. Rep. 41 pp.

Millar, J.B. 1987a. Baseline (1985) habitat estimates for the settled portions of the Prairie Provinces. Report #1: Methods and project status. Can. Wildl. Serv. Unpubl. Rep. 50 pp.

Millar, J.B. 1988b. Baseline (1985) habitat estimates for the settled portions of the Prairie Provinces. Report # 2: Saskatchewan Parkland - Part I. Can. Wildl. Serv. Unpubl. Rep. 44 pp.

Millar, J.B. 1989c. Baseline (1985) habitat estimates for the settled portions of the Prairie Provinces. Report # 3: Saskatchewan Parkland - Part II. Can. Wildl. Serv. Unpubl. Rep. 65 pp.

Millar, J.B. 1992d. Baseline (1985) habitat estimates for the settled portions of the Prairie Provinces. Report # 4: Alberta Parkland. Can. Wildl. Serv. Unpubl. Rep. 72 pp.

Millar, J.B. 1992e. Baseline (1985) habitat estimates for the settled portions of the Prairie Provinces. Report # 5: Alberta Mixedgrass Prairie. Can. Wildl. Serv. Unpubl. Rep. 66 pp.

Millar, J.B. 1992f. Baseline (1985) habitat estimates for the settled portions of the Prairie Provinces. Report # 6: Alberta Fescue Prairie. Can. Wildl. Serv. Unpubl. Rep. 58 pp.

Millar, J.B. 1992g. Baseline (1985) habitat estimates for the settled portions of the Prairie Provinces. Report # 7: Alberta Shortgrass Prairie. Can. Wildl. Serv. Unpubl. Rep. 38 pp.

Millar, J.B. 1992h. Baseline (1985) habitat estimates for the settled portions of the Prairie Provinces. Report # 8: Saskatchewan Mixedgrass Prairie. Can. Wildl. Serv. Unpubl. Rep. 86 pp.

Millar, J.B. 1992i. Baseline (1985) habitat estimates for the settled portions of the Prairie Provinces. Report # 9: Saskatchewan Shortgrass Prairie. Can. Wildl. Serv. Unpubl. Rep. 52 pp.

Millar, J.B. 1993j. Baseline (1985) habitat estimates for the settled portions of the Prairie Provinces. Report # 10: Manitoba Parkland. Can. Wildl. Serv. Unpubl. Rep. 84 pp.

Millar, J.B. 1993k. Baseline (1985) habitat estimates for the settled portions of the Prairie Provinces. Report # 11: Manitoba Mixedgrass and Tallgrass. Can. Wildl. Serv. Unpubl. Rep. 62 pp.

Millar, J.B. 1993l. Baseline (1985) habitat estimates for the settled portions of the Prairie Provinces. Report # 12: Manitoba Mid-Boreal Transition. Can. Wildl. Serv. Unpubl. Rep. 66 pp.

Millar, J.B. 1993m. Baseline (1985) habitat estimates for the settled portions of the Prairie Provinces. Report # 13: Saskachewan Mid-Boreal Transition. Can. Wildl. Serv. Unpubl. Rep. 63 pp.

North American Waterfowl Management Plan. Saskatchewan Implementation. June 1989.

North American Waterfowl Management Plan. Prairie Habitat Joint Venture. Manitoba Implementation Plan. Executive Summary 1988.

North American Waterfowl Management Plan. Manitoba Implementation Plan 1997-2001. An Update to the Manitoba Implementation Plan. 1988.

Prairie Conservation Forum. January 2001. Alberta Prairie Conservation Action Plan: 2001-2005. Published by the Prairie Conservation Forum. Lethbridge. Alberta. 34 pages

Prairie Habitat Joint Venture. Implementation of the North American Waterfowl Management Plan in Alberta. 1989. Alberta Forestry. Lands and Wildlife. Canadian Wildlife Service. Ducks Unlimited Canada. Wildlife Habitat Canada. Alberta Agriculture.

Prairie Habitat Joint Venture. Prairie Habitat: A Prospectus

Rakowski, P.W. and B.P. Chabot. 1983. Changes in land use in the Minnedosa district of southwestern Manitoba: an update on the Kiel-Hawkins transects. Unpubl. Can. Wildl. Serv. Report, Winnipeg, Manitoba. 10 pp.

Rakowski, P., R.W. Nero, and R.C. Hutchison. 1974. Present status of waterfowl habitat in the prime duck production area of Manitoba. Unpubl. Can. Wildl. Serv. Report. 12 pp.

Research Branch Agriculture and Agri-Food Canada. A National Ecological Framework for Canada. 1996. Cat. No. A42-65/1996E ISBN 0-24107-X.

Schick, C.D. 1972. A documentation and analysis of wetland drainage in Alberta Parkland. Unpubl. Can. Wildl. Serv. Report. 15 pp.

Statistics Canada. 1997. Historical Overview of Canadian Agriculture. Catalogue No. 93-358-XPB. 253 pp.

Statistics Canada. 2001. Land tenure data from 1986, 1991, and 1996 agriculture census. Special request. Statistics Canada.

Tiner, Ralph W. 1999. Wetland Indicators: A guide to wetland Identification, Delineation, Classification, and Mapping. CRC press LLC. 392 pp

Turner, Bruce C., George S. Hochbaum, F.D. Caswell, and Daniel J. Nieman. 1987. Agricultural Impacts on Wetland Habitats on the Canadian Prairies, 1981-85. Trans. 52nd N.A. Wildl. & Nat. Res. Conf. Pp 207-215

U.S. Fish and Wildlife Service. 2001. Waterfowl population status, 2001. U.S. Department of the Interior, Washington, D.C. 50 pp.

Wildlife Habitat Canada. The Status of Wildlife Habitats in Canada 2001. ISBN 0-921553-30-7

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